SECTION X

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United States Patent [19]

Boyer

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[54] FAN/RADIATOR COMBINATION FOR SNOWMOBILE WITH LIQUID COOLED ENGINE

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[21] Appl. No.: 629,448

[22] Filed: Dec. 18, 1990

[51] Int. Cl.[5] B62D 27/00

[52] U.S. Cl. 180/68.1; 60/321; 180/68.4

[58] Field of Search 123/41.57, 41.72; 60/321; 180/309, 68.1, 68.4, 68.3

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4,604,974	8/1986	Watanabe	123/41.57
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Primary Examiner—Andres Kashnikow

Assistant Examiner—Michael Mar

Attorney, Agent, or Firm—Haugen and Nikolai

[57] ABSTRACT

An improved liquid cooled heat management system for a snowmobile vehicle is described. To maintain the under-the-hood air temperature at optimum operating values while providing the necessary cooling for the vehicle's internal combustion engine, an air inlet opening is formed in the hood or other body panel of the snowmobile defining the engine compartment and disposed within this engine compartment is an appropriately sized heat exchanger through which the liquid coolant is made to flow when the engine is running. The air inlet opening in the hood or body panel leads into a duct or shroud designed to enclose the heat exchanger or radiator on the fan suction side and a engine-driven fan also disposed within the duct draws outside air through the heat exchanger at a rate that is directly related to engine speed. Because of the manner in which the duct work is structured, warmer, under-the-hood air is effectively isolated from the stream of cold outside air drawn through the heat exchanger. Furthermore, the engine's exhaust manifold is also liquid-cooled which further enhances the overall efficiency of the system.

5 Claims, 3 Drawing Sheets

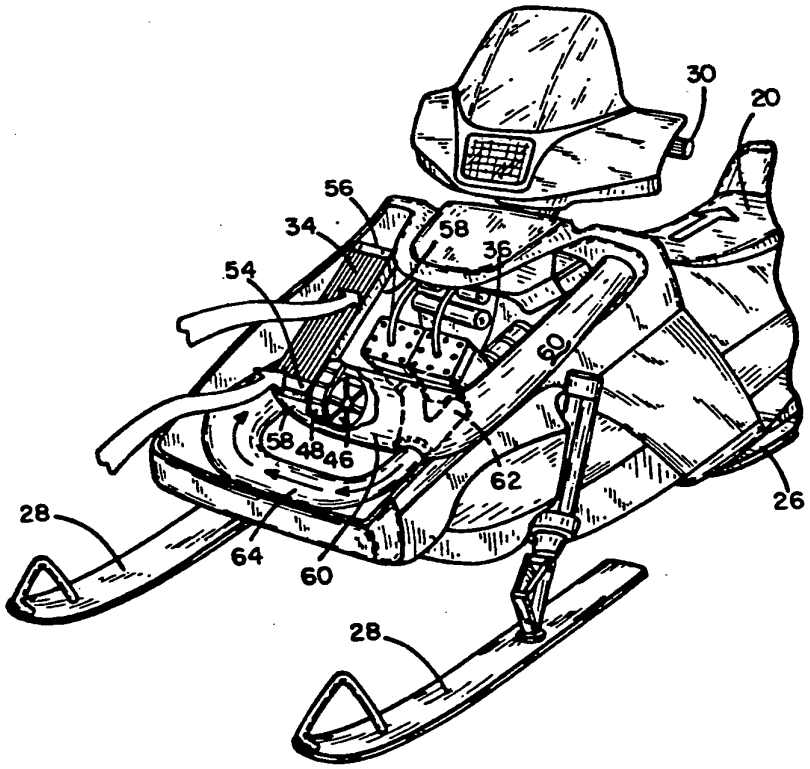

Fig. 1

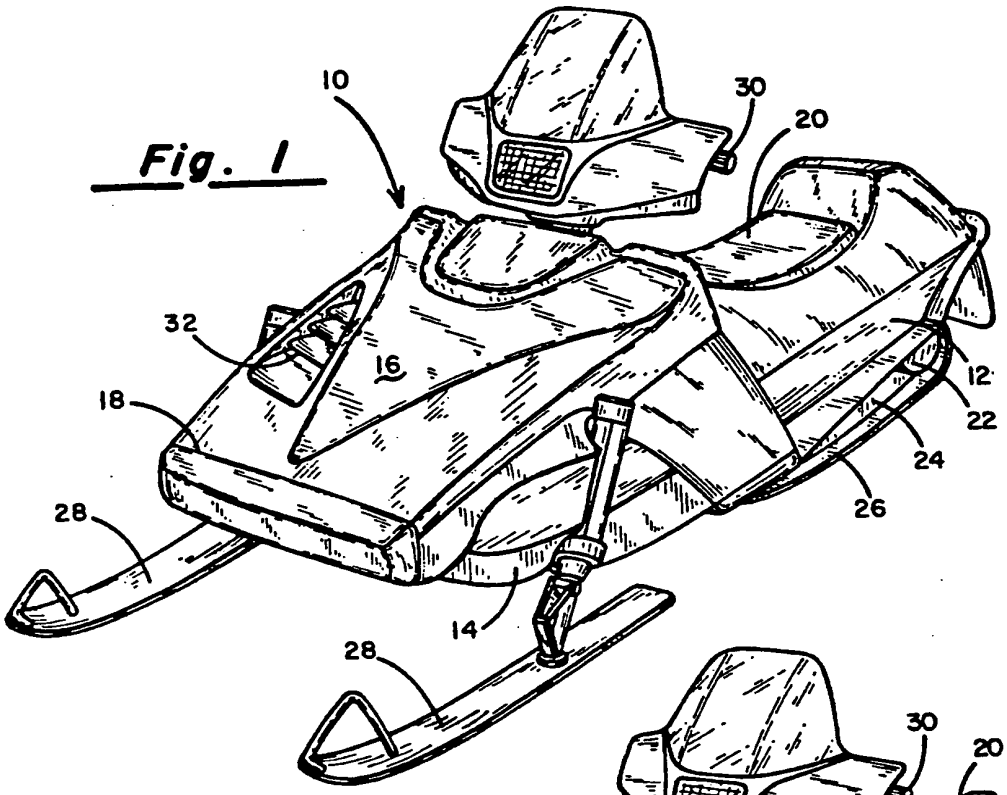
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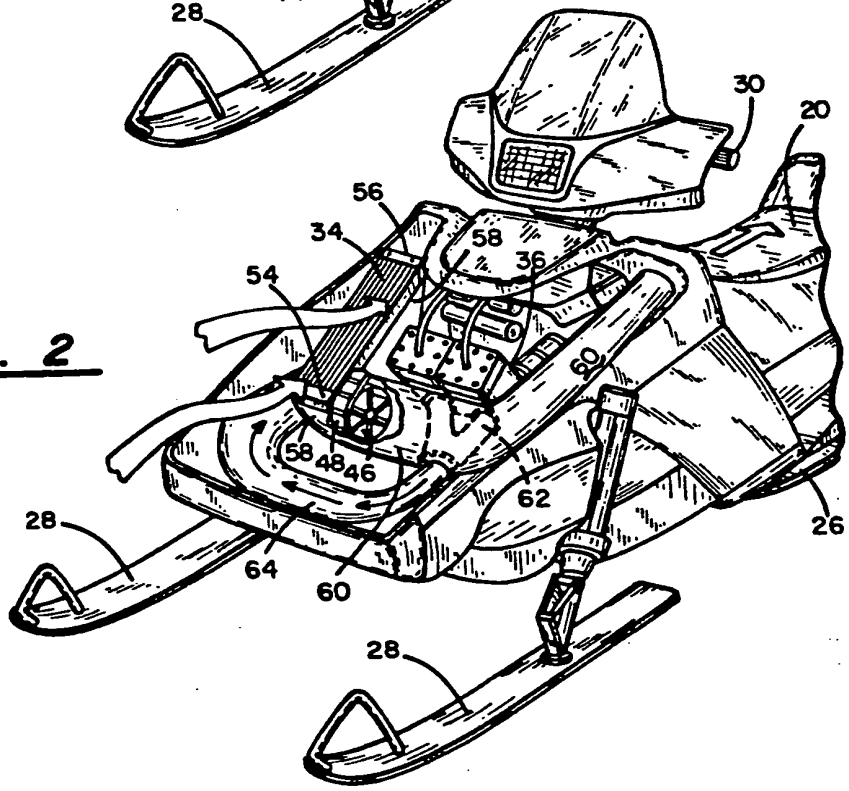
Fig. 2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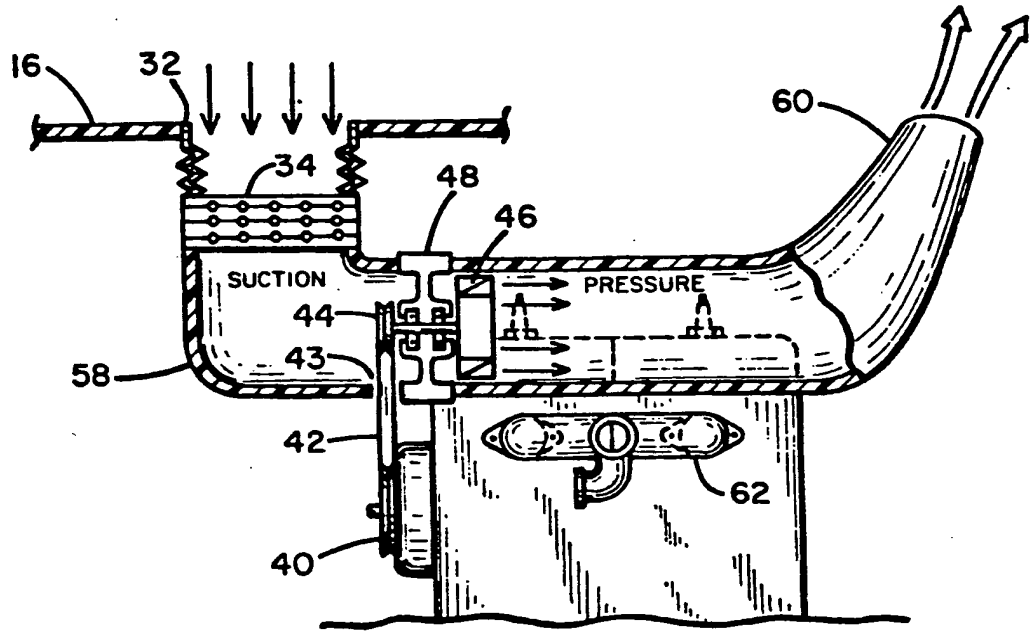
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Fig. 3A

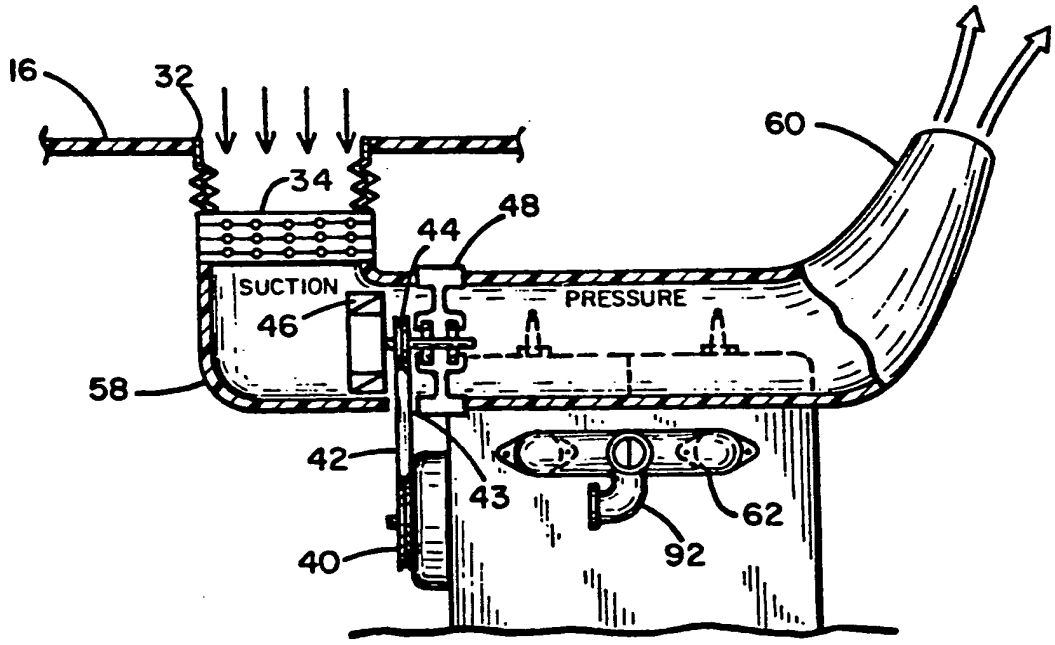
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Fig. 3B

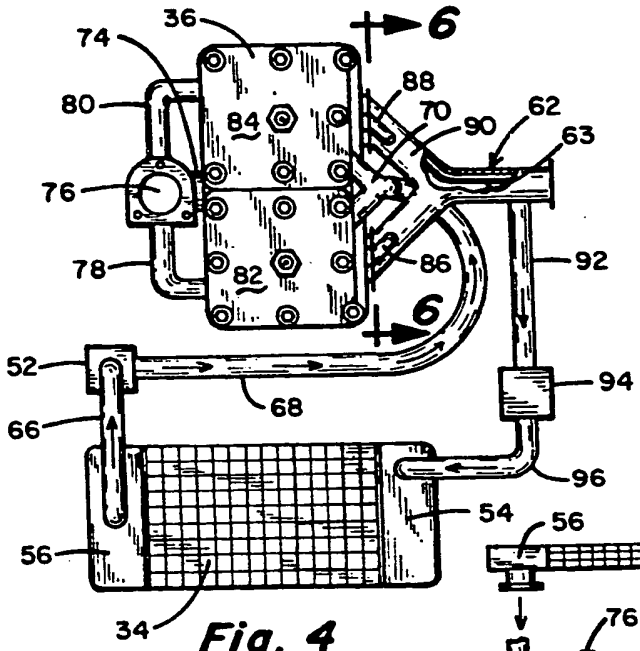

Fig. 4

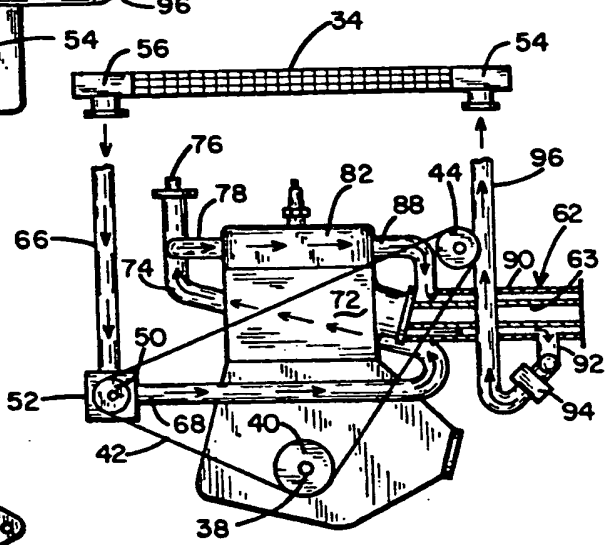

Fig. 5

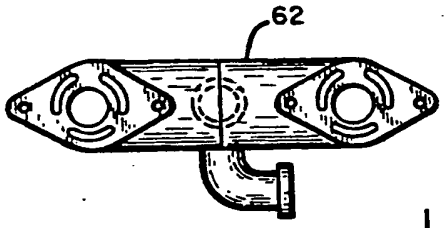

Fig. 7

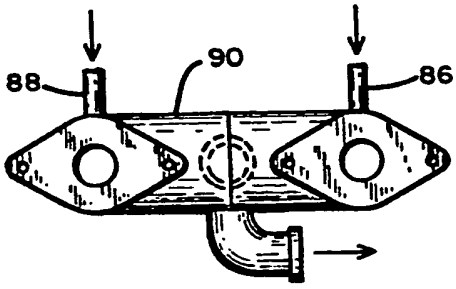

Fig. 6

FAN/RADIATOR COMBINATION FOR SNOWMOBILE WITH LIQUID COOLED ENGINE

BACKGROUND OF THE INVENTION

I. Field of the Invention

This invention relates generally to snowmobile-type recreational vehicles, and more particularly to an improved cooling system for such vehicles where the cooling capacity is directly proportional to engine power, allowing a more consistent engine temperature control under varying ambient conditions.

II. Discussion of the Prior Art

Various approaches are known in the art for cooling the internal combustion engine used to power snowmobile-type vehicles. In a first arrangement in the case of low horse power machines, the engine may be totally air-cooled by providing an appropriate opening in the engine cowl so that as the vehicle moves through the snow, air is rammed through the opening and made to flow across the exposed exterior surfaces of the engine. When idling or when travelling through deep snow, the ground speed of the vehicle may be such that insufficient air flows over the engine surfaces to provide adequate cooling and an over-temperature condition will frequency arise. This method is wholly unsuited for current machines due to sound level restrictions.

Another known cooling system is disclosed in U.S. Pat. No. 4,340,123 assigned to Kawasaki incorporates a liquid coolant heat exchanger which extends along the tunnel of the snowmobile at a location above the track assembly and below the seat. A combination of air flow and melting snow splashed onto the heat exchanger by the drive track carries the heat away from the recirculating coolant pumped through the coolant passages formed in the engine. Systems of this type which rely on a snow-splash cooled heat exchangers are dependent on outside conditions and not the cooling load and, therefore, do not maintain a constant temperature range under varying ambient conditions. For example, when traversing compacted snow or ice, very little snow is splashed by the drive track onto the heat exchanger and, accordingly, heat removal is achieved solely by the air which is made to pass over the heat exchanger. Again, if the vehicle is being driven at a slow speed for a prolonged time interval, say, over a frozen lake, overheating can occur due to the inability of the heat exchanger to dissipate all of the heat generated by the engine. Moreover, systems such as disclosed in the aforereferenced Kawasaki patent often result in slush freezing on the tunnel surfaces and track suspension member, increasing the weight of the machine and adversely affecting performance. Moreover, with the heat exchanger disposed in the snowmobile's tunnel, the clearance between the drive track and the heat exchanger reduces the suspension stroke available, making it difficult to provide a comfortable ride.

The Fields et al. U.S. Pat. No. 4,249,626 also assigned to Kawasaki describes a snowmobile having a liquid-cooled engine with a radiator element positioned in front of a hood louver whereby air entering through the louvers as the machine is being driven passes through the radiator to extract the heat from the coolant liquid. Again, this type of design suffers from the fact that the amount of cooling provided is dependent to a large extent on ambient conditions, such as speed of travel, snow conditions, etc. and not to the power being generated by the vehicle's internal combustion engine. The amount of venting required to introduce the necessary cooling air also compounds the problem of snowmobile engine noise emissions and, accordingly, it is generally desirable to reduce, as much as possible, the area of openings in the vehicle's cowl or hood.

The prior art has also failed to adequately address a major heat source located beneath the vehicle's hood. More specifically, it is found that the engine's exhaust manifold, sometimes referred to as a "Y-pipe" in the case of a two cylinder engine, is a major source of under-the-hood heating Unless proper attention is paid to under-hood temperatures, such problems as vapor lock, heat bogging, and shortening of V-belt life occur.

OBJECTS

It is accordingly a principal object of the present invention to provide an improved heat management system for a snowmobile-type vehicle which is relatively independent of outside ambient conditions.

Another object of the invention is to provide a heat management system for a snowmobile allowing improved performance by way of consistent power, improved throttle response, reduced noise emissions and less down-time.

SUMMARY OF THE INVENTION

The foregoing features, objects and advantages are achieved in accordance with the present invention by providing a radiator-type heat exchanger disposed beneath the hood in the engine compartment of the snowmobile and with a fan and water pump driven by the engine. A duct or shroud is provided about the air inlet opening in the hood or body, the radiator and the fan in such a way that only cold outside air is drawn through the radiator with warmer, under-the-hood air effectively isolated. The water pump circulates liquid coolant through the engine and its exhaust manifold and then through the radiator where the heat is given off to the air stream flowing through the shroud and fan. By providing the fan and shroud arrangement in combination with the radiator, sufficient heat exchanger efficiency is provided to permit a closed or recirculating cooling system to be used to cool both the engine and the exhaust manifold.

Given the size constraints associated with the snowmobile's engine compartment, it is through the ducting arrangement that a relatively small radiator can be used while still providing sufficient heat transfer capability to maintain the engine and exhaust manifold cool enough so that problems due to vapor lock and bogging do not occur.

Furthermore, in the system of the present invention, both the fan speed and the engine power are proportional to engine rpm. Hence, the cooling capacity is also proportional to engine power, allowing more consistent temperature control under varying ambient conditions, such as outside temperature, altitude, snow depth, etc.

Since only a single opening need be made through the hood or through a side panel of the body to allow the introduction of cold outside air into the ducting system surrounding the radiator and fan and because the ducting system effectively isolates the cold air inlet opening from the engine, noise emissions through the cold air inlet opening are minimized.

Still a further advantage emanating from the improved cooling system configuration of the present invention is that all metal surfaces under the hood are

effectively maintained at a sufficiently low temperature that plastic parts may be brought into close proximity with those surfaces without damage to those parts due to melting. As such, the size of the engine compartment can be reduced for styling considerations without fear that over-crowding will result in parts failure.

Those skilled in the art will recognize that automotive cooling systems have incorporated radiator/fan combinations for removing heat energy from a liquid coolant, but in the case of automobiles, under-the-hood space constraints tend not to be a limiting factor. Automobile cooling systems also rely on ram air impinging on the radiator surface for cooling at travel speeds with the fan providing the air flow at low or idle speeds.

DESCRIPTION OF THE DRAWINGS

The foregoing features, objects and advantages of the invention will become apparent to those skilled in the art from the following detailed description of a preferred embodiment, especially when considered in conjunction with the accompanying drawings in which like numerals in the several views refer to corresponding parts.

FIG. 1 is a perspective view of a snowmobile vehicle in which the heat management system of the present invention is incorporated;

FIG. 2 is a partial perspective view of the snowmobile of FIG. 1 with the hood or cowl removed to allow viewing of the engine and portions of its cooling system;

FIG. 3A is a view of a portion of the heat management system incorporated in the snowmobile of FIG. 1 showing one way of locating a fan;

FIG. 3B is a view of a portion of the heat management system showing an alternative way of locating the fan;

FIG. 4 is a schematic mechanical drawing showing the liquid coolant flow path;

FIG. 5 is a side elevation of the snowmobile engine and the liquid coolant flow path;

FIG. 6 is a cross-sectional view taken along the lines 6—6 in FIG. 4;

FIG. 7 is a drawing showing an alternative way of providing a water cooled exhaust manifold

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1, there is indicated generally by numeral 10, a snowmobile-type vehicle which includes a frame assembly including a main frame member 12 whose cross-section is substantially an inverted U-shape with a bottom cover 14 fixed on the underside of a forward portion of the main frame and a cowl 16 made of, for example, FRP (fiber reinforced plastics) and pivotally connected at 18 to a forward end of the bottom cover 14. Affixed to the main frame 12 is a longitudinally elongated seat member 20 on which a driver may sit.

Located below the main frame 12 are plural pairs of guide wheels as at 22 and a pair of guide rails 24 are supported on the main frame in a well-known manner. While not shown in FIG. 1, in the forward section of the snowmobile is disposed a drive sprocket wheel and an endless belt or track 26 having a plurality of transversely extending projections on its outer face is stretched over the guide wheels 22, the guide rails 24 and the drive sprocket wheel, all in a conventional manner. The drive sprocket wheel is, in turn, driven by an engine through a variable speed transmission in a manner which will be described with greater particularity hereinbelow.

The drive track assembly is disposed within the U-shaped main frame member 12 directly below the seat 20 in a zone commonly referred to as the "tunnel". A dampened suspension system supports the drive track assembly to the frame allowing relative vertical movement between the drive track assembly and the frame, thereby isolating the rider from undue shock as the vehicle traverses rough terrain.

Suspended from the forward portion of the frame are steerable skis as at 28, the skis being coupled through a conventional tie bar linkage to a steering column (not shown). The steering column can be rotated by appropriate lateral rotation of the vehicle's handlebars 30.

With continued reference to FIG. 1, it can be seen that the hood or cowl 16 includes a louvered air inlet opening 32 disposed on the right-hand side thereof at a predetermined location which is generally in alignment with a radiator 34 shown in FIG. 2. FIG. 2 illustrates a portion of the snowmobile of FIG. 1 with the hood 16 removed to expose the engine and heat management system comprising the present invention. While the air inlet opening 32 is shown as passing through the hood, those skilled in the art will appreciate that the opening may be made in the other panels defining the vehicle's engine compartment.

Mounted to the frame 12 within the engine compartment is a multi-cylinder (two) internal combustion engine which is identified by numeral 36 and, as can best be seen in the engine side view of FIG. 5, it includes a transversely extending output shaft 38. A pulley 40 is secured to the shaft and trained about the pulley 40 is an endless V-belt 42 which also passes around a fan drive pulley 44 which is affixed to the drive shaft of a fan impeller 46 (FIG. 2) which is journaled for rotation in a fan housing 48. The V-belt 42 is also trained about a pulley 50 (FIG. 5) secured to the shaft of a water pump 52.

As indicated in FIG. 2, the radiator or heat exchanger 34 is conventional in that it comprises a plurality of metal tubes extending between an inlet header 54 and an outlet header 56, thereby providing parallel liquid coolant flow paths. Extending transversely to the plural tubes are a large plurality of closely-spaced conductive metal fins which are joined to the metal tubes of the radiator. As air passes over and between the fins, heat energy is transferred to the air stream, thereby effecting a cooling of the liquid coolant passing through the heat exchanger member 34. The shroud is shown broken away in FIG. 2 to allow viewing of the fan assembly 46 and 48 which is also surrounded by the shroud. The shroud 58 terminates in a duct segment 60 of generally circular cross-section. The air passing through the duct 60 may exit through a suitable grill (not shown) formed in the dashboard of the snowmobile vehicle so as to be directed upon the rider to provide some measure of warmth and comfort if desired Alternatively, the warmed air can be made to exit through an opening (not shown) in the hood or other body panel.

Located beneath the duct 60 in FIG. 2 is an exhaust manifold 62 and, for a two cylinder engine 36, as illustrated, it may comprise a Y-shaped pipe for collecting exhaust gases from each cylinder and conveying those gases to an exhaust pipe 64. It has been found that heat radiated from the exhaust manifold in conventional, prior art snowmobiles is a major contributor to the under-the-hood heat present in the engine compart-

ment. In the snowmobile of the present invention, not only are the cylinder block and cylinder heads of the engine liquid cooled, but so too is the exhaust manifold. The manner in which this is accomplished will next be explained.

Referring to FIG. 3A, there is shown a front elevation of a portion of the heat management system where the opening through the duct or shroud 58 to accommodate the drive belt 42 is on the suction side of the fan 46. Specifically, two holes as at 43 are provided through the shroud 58, allowing the V-belt 42 to extend from the motor drive pulley 40 to the fan pulley 44. Since the openings 43 are on the suction side of the fan 46, a relatively small amount of air from under the hood is allowed to pass and it relieves or compromises the suction generated by the fan 46, thereby decreasing the air flow across the radiator 34. By reversing the orientation of the fan 46 as shown in FIG. 3B, the openings 43 through which the V-belt 42 passes now are on the high pressure side of the fan which does not compromise the amount of outside air flowing through the radiator 34. Thus, while the arrangement shown in FIG. 3A remains totally feasible, that shown in FIG. 3B has been shown to be slightly more efficient in terms of the volume of air which can be drawn across the heat exchanger or radiator 34 for a given size fan.

Referring to FIGS. 4 and 5, the liquid coolant flow path will next be explained. As can be seen in FIG. 4, a radiator hose 66 joins the radiator's outlet header 56 to the suction side of the water pump 52 while hose 68 joins the water pump's outlet to the coolant inlet connector 70 attached to the engine block 72 (FIG. 5). Coolant then traverses the coolant passages (not shown) formed in the block 72 and then exit the block, via pipe 74. The pipe 74 has a coolant liquid filler cap 76 at the upper end thereof and two branches 78 and 80 lead to the cylinder heads 82 and 84, respectively. The coolant liquid flows through passages formed in the heads 82 and 84 and then exits the head via hoses 86 and 88, respectively. Hoses 86 and 88 lead to a water jacket 90 surrounding the Y-pipe (exhaust manifold) 62. In the arrangement of FIGS. 4–6, the Y-pipe assembly comprises an inner tubular member 63 which carries the exhaust gases and a coaxially disposed outer member 90 which is spaced from the inner member to provide a liquid coolant passage surrounding the exterior of the inner pipe 63. The liquid coolant exiting the heads 82 and 84, thus flows through the hoses 86 and 88 into the space between the inner and outer tubes to flood that space with liquid coolant. The coolant exits the Y-pipe assembly 62, via a plumbing outlet 92, leading to a thermostat valve 94 which operates in a conventional fashion to open upon reaching a predetermined upper temperature and allowing the coolant to flow through a further hose 96 to the radiator's inlet header 54.

As shown in FIG. 7, rather than utilizing two coaxially tubes to create a water packet about the exhaust manifold, it is also possible to cast an exhaust manifold so as to incorporate internal passages in the wall thereof.

In operation, as the engine 36 drives the water pump 52, a liquid coolant is circulated through the cooling passages in the engine block 72, the cylinder heads 82 and 84 and through the water jacket surrounding the exhaust manifold 62. This coolant also circulates through the radiator 34. Cold outside air is drawn through the louvered opening 32 formed in the hood and through and over the fins of the radiator 34. The air is drawn by the engine-driven fan 46 from the shroud 58 and forced out through the duct 60 and then expelled out of the hood. Because the duct or shroud 58 totally encloses the suction side of the radiator, there is substantially no leakage of warm under-the-hood air into the air stream, to thereby reduce the effective cooling air flowing through the radiator surfaces. Hence, neat transfer efficiency is optimized. Moreover, because the exhaust manifold 62 is also liquid-cooled, the under-the-hood air temperature is significantly reduced over what would otherwise prevail when the exhaust header is not so cooled. By properly managing the air temperature under-the-hood, problems such as vapor locks and bogging no longer occur. Also, the need for large, multiple hood openings and costly heat insulating material is eliminated.

This invention has been described herein in considerable detail in order to comply with the Patent Statutes and to provide those skilled in the art with the information needed to apply the novel principles and to construct and use such specialized components as are required. However, it is to be understood that the invention can be carried out by specifically different equipment and devices, and that various modifications, both as to the equipment details and operating procedures, can be accomplished without departing from the scope of the invention itself.

What is claimed is:

1. In a snowmobile of the type including a frame, a body supported on said frame, said body including an engine compartment and a hood secured to said body in covering relation with respect to said engine compartment, an internal-combustion engine mounted in said engine compartment, said engine including an output shaft and liquid coolant passages extending through a cylinder block and cylinder head, the improvement comprising:

(a) an air inlet opening formed through the thickness dimension of said body at a predetermined location relative to said engine compartment;

(b) a radiator of the type including tube means held in spaced relation by a plurality of heat conducting fins for conveying a coolant liquid therethrough and disposed in said engine compartment in generally sealed relation with and proximate said air inlet opening in said body;

(c) fan means operatively coupled to said output shaft for forcing air entering said opening over said heat conducting fins at a rate substantially proportional to the generated engine heat output;

(d) sealed duct means disposed in said engine compartment and including a first portion surrounding said fan and said radiator for effectively excluding air in said engine compartment external of said duct means from the air stream being moved over said heat conducting fins by said fan, said first portion maintaining a negative pressure between said radiator and said fan for drawing air through said heat conducting fins;

(e) said sealed duct means having a second portion downstream of said fan for exhausting heated air to the ambient;

(f) coolant pump means operatively coupled to said output shaft to be driven by said shaft, said pump having a suction inlet and a pressure outlet;

(g) hose means for coupling said inlet and outlet of said coolant pump means in fluid circuit with said tube means of said radiator and with said liquid

coolant passages in said cylinder block and cylinder head, and

(h) an exhaust connection attached to said engine within said engine compartment for carrying exhaust gases from one or more cylinders of said engine to an exhaust pipe, said exhaust connection having liquid coolant passages within the walls thereof, said liquid coolant passages of said exhaust connection being in said fluid circuit and isolated from said exhaust gases.

2. The snowmobile as in claim 1 wherein said second portion of said duct means includes an outlet external of said engine compartment.

3. The snowmobile as in claim 1 wherein said exhaust connection comprises a generally Y-shaped tube and said liquid coolant passages are formed in the walls of said Y-shaped tube.

4. The snowmobile as in claim 1 wherein said exhaust connection includes first and second coaxially disposed, spaced-apart tubes, exhaust gases passing through the center of the innermost tube and said liquid coolant flowing through the center of the outermost tube.

5. The snowmobile as in claim 1 wherein said hood is in covering relation relative to said engine compartment and said air inlet opening is formed in said hood.

* * * * *

US005152365A

United States Patent [19]

Aoshima

[11] Patent Number: 5,152,365

[45] Date of Patent: Oct. 6, 1992

[54] AIR INTAKE SYSTEM FOR SMALL SNOWMOBILE

[75] Inventor: Yasushi Aoshima, Iwata, Japan

[73] Assignee: Yamaha Hatsudoki Kabushiki Kaisha, Iwata, Japan

[21] Appl. No.: 639,963

[22] Filed: Jan. 11, 1991

[30] Foreign Application Priority Data

Jan. 12, 1990 [JP] Japan 2-3329

[51] Int. Cl.[5] B60K 13/02

[52] U.S. Cl. ..... 180/68.3; 180/68.2; 123/41.7; 123/198 E

[58] Field of Search ..... 180/68.2, 68.3, 69.2; 123/41.6, 41.62, 41.7, 41.04, 178 E; 55/385.3

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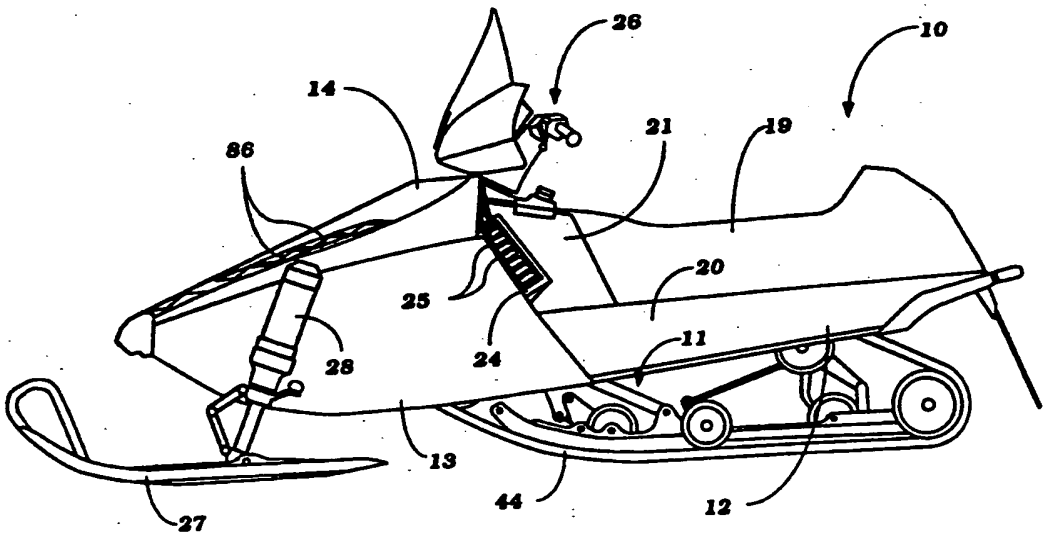
Primary Examiner—Andres Kashnikow
Assistant Examiner—Richard Camby
Attorney, Agent, or Firm—Ernest A. Beutler

[57] ABSTRACT

An air intake system for a snowmobile which comprises an internal combustion engine having an induction system. A body is provided which cooperates in defining an engine compartment wherein the engine and induction system are contained. This body has an opening for inducting air from the atmosphere and is in communication with a passageway which defines an air flow path from the opening to the induction system so that air flows from the opening to the induction system without accumulating in the engine compartment. A filter element is positioned between the opening and the induction system across the air flow path such that the air flows in a generally upward direction through the filter element. The filter element not only prevents snow and ice from being sucked into the induction system but also prevents these elements from clogging the filter, while still allowing for adequate air flow to the induction system.

4 Claims, 8 Drawing Sheets



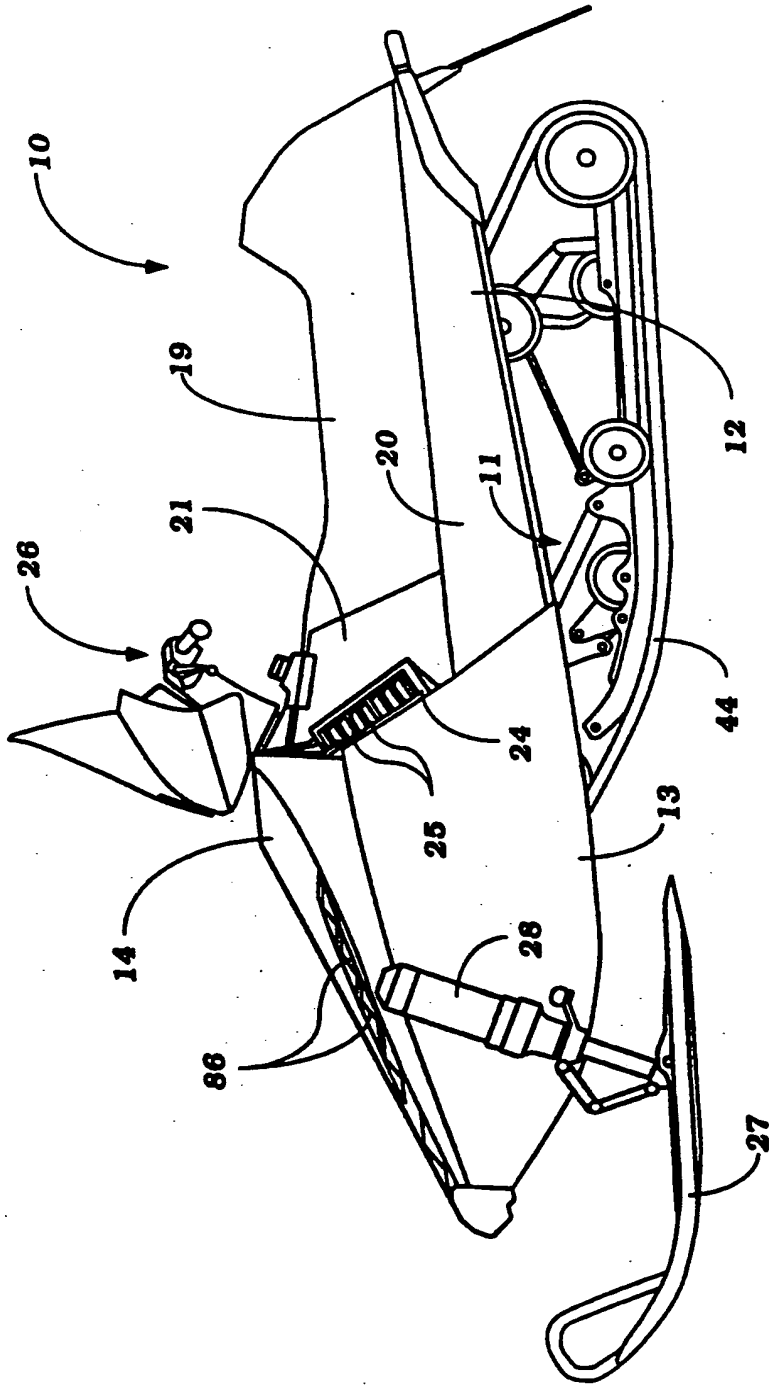


Figure 1

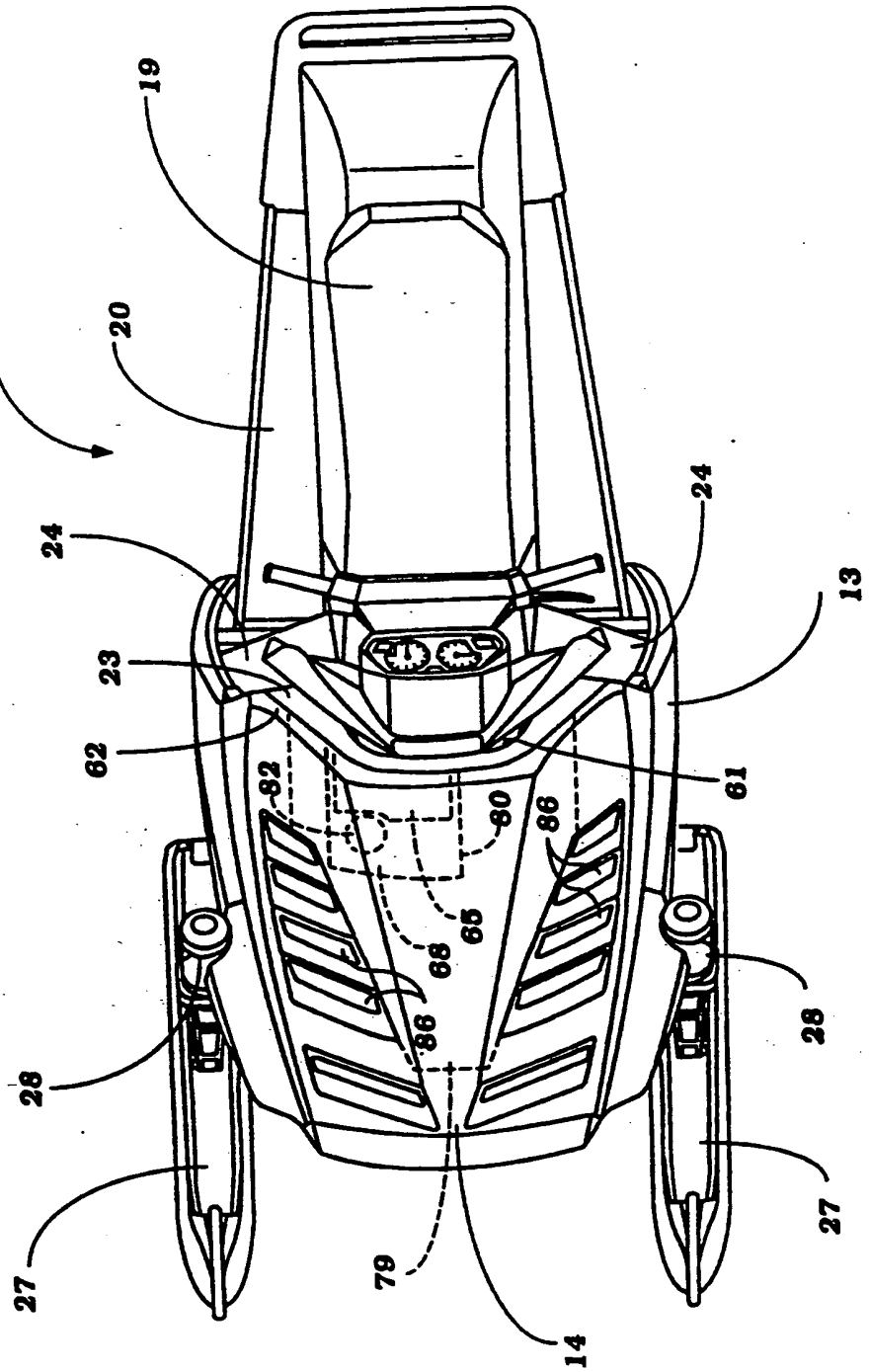


Figure 2

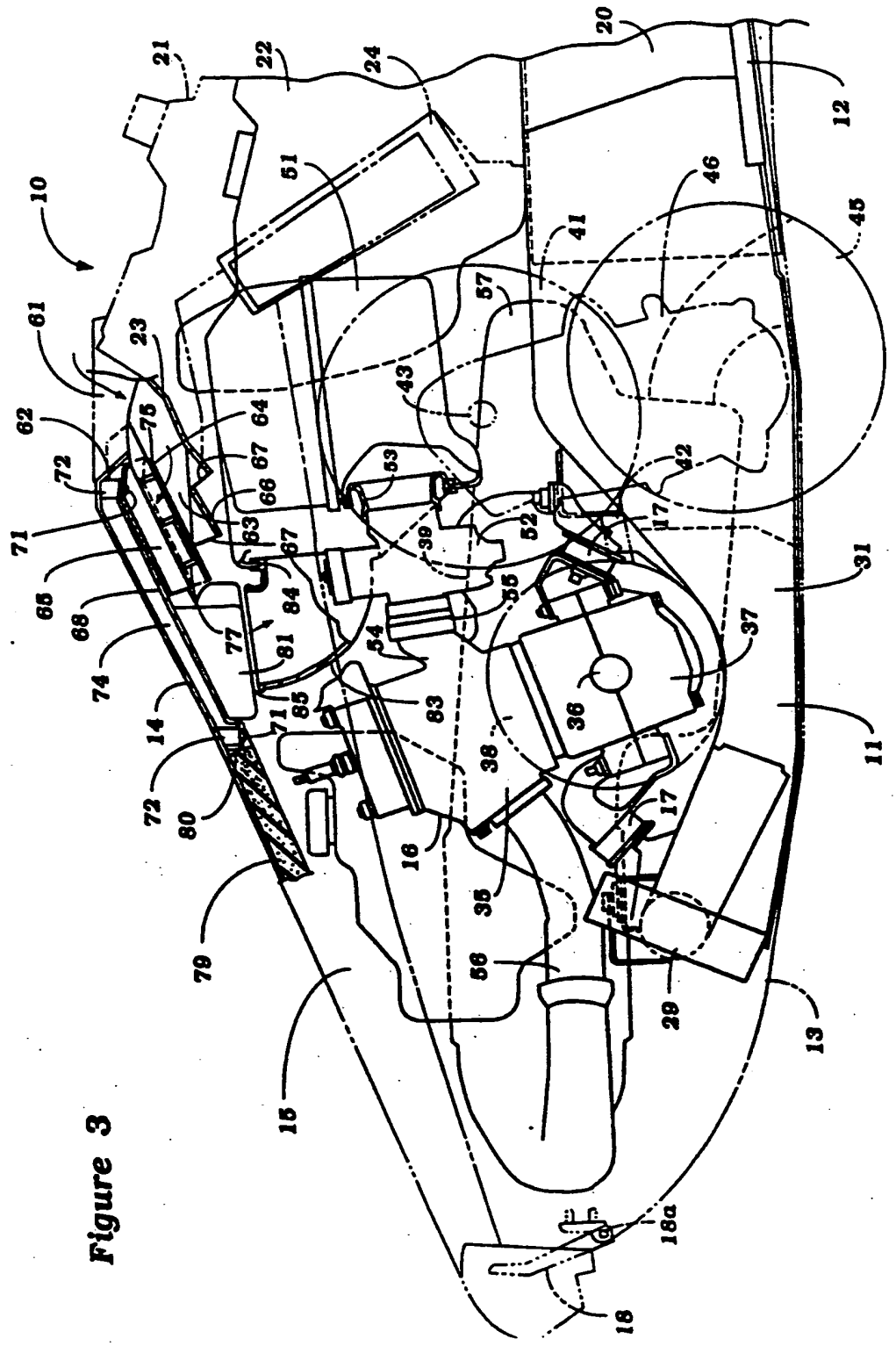

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Figure 3

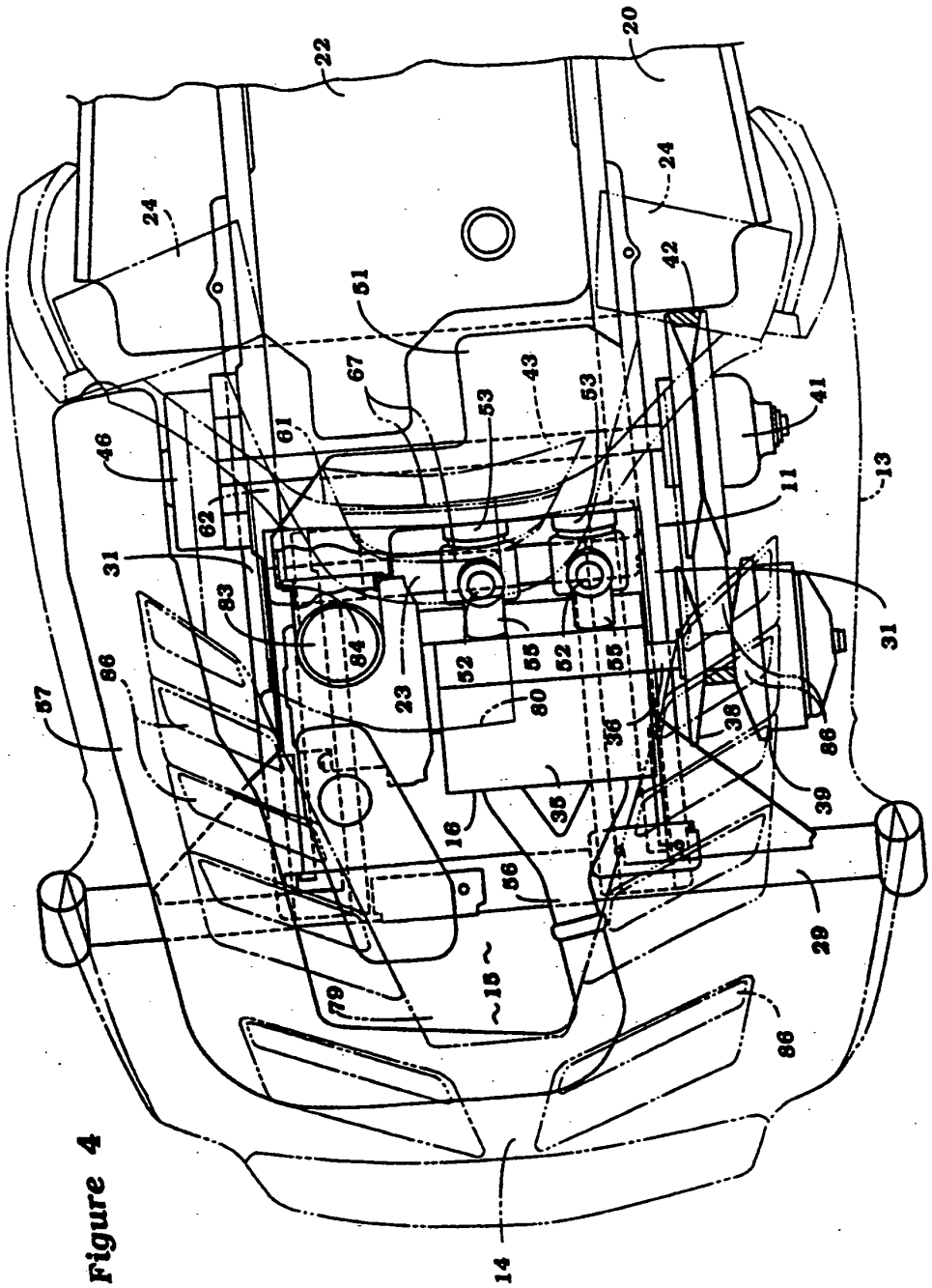
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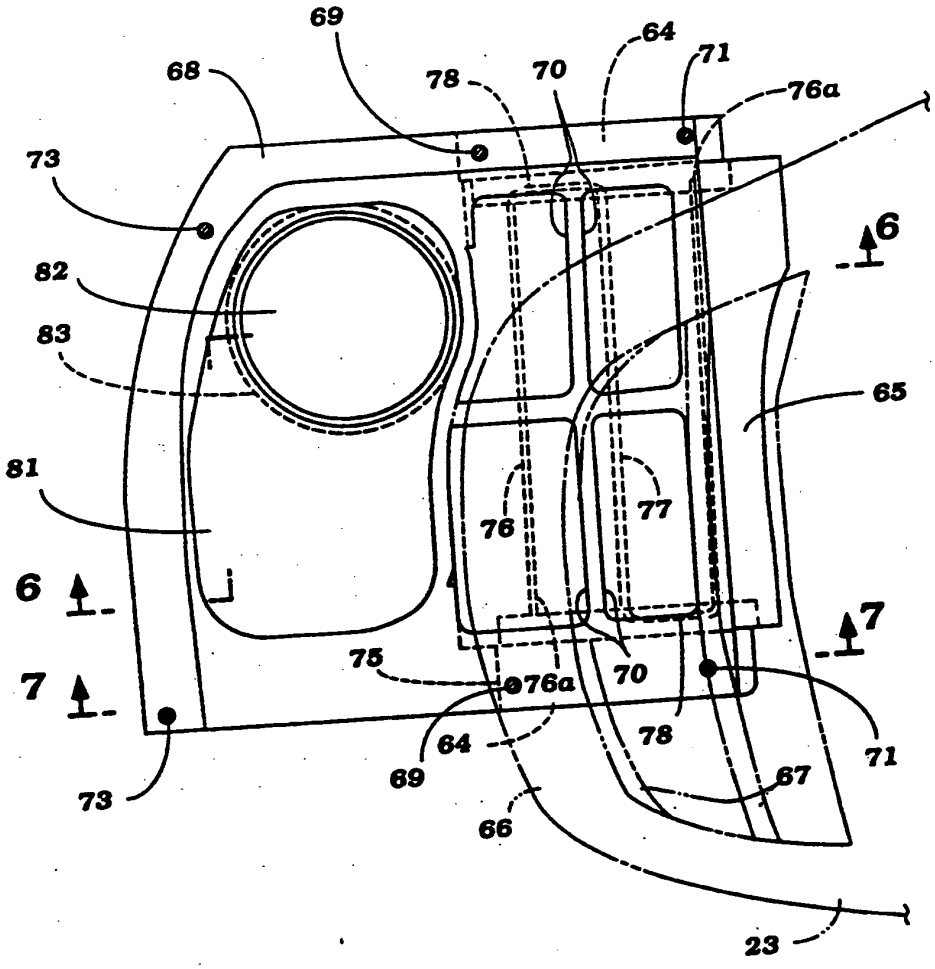
Figure 4

Figure 5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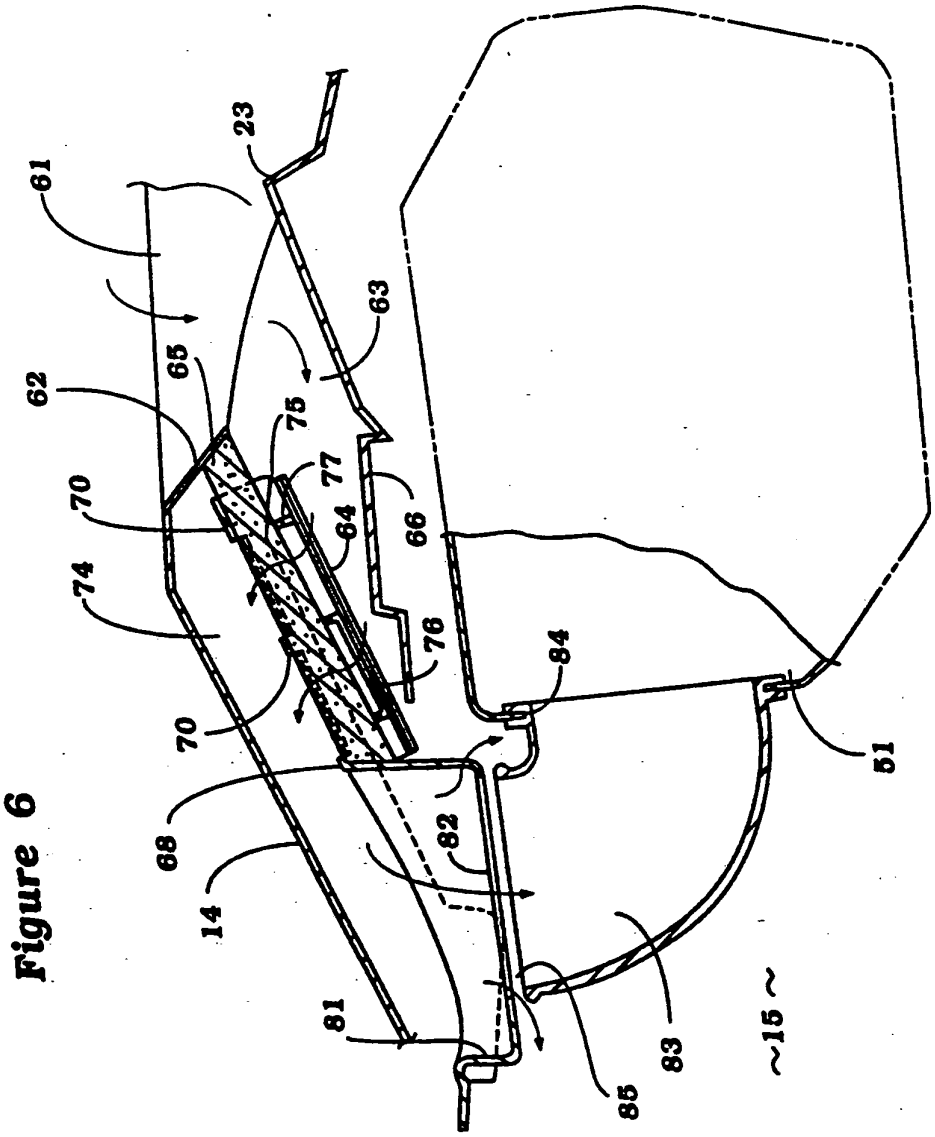

Figure 6

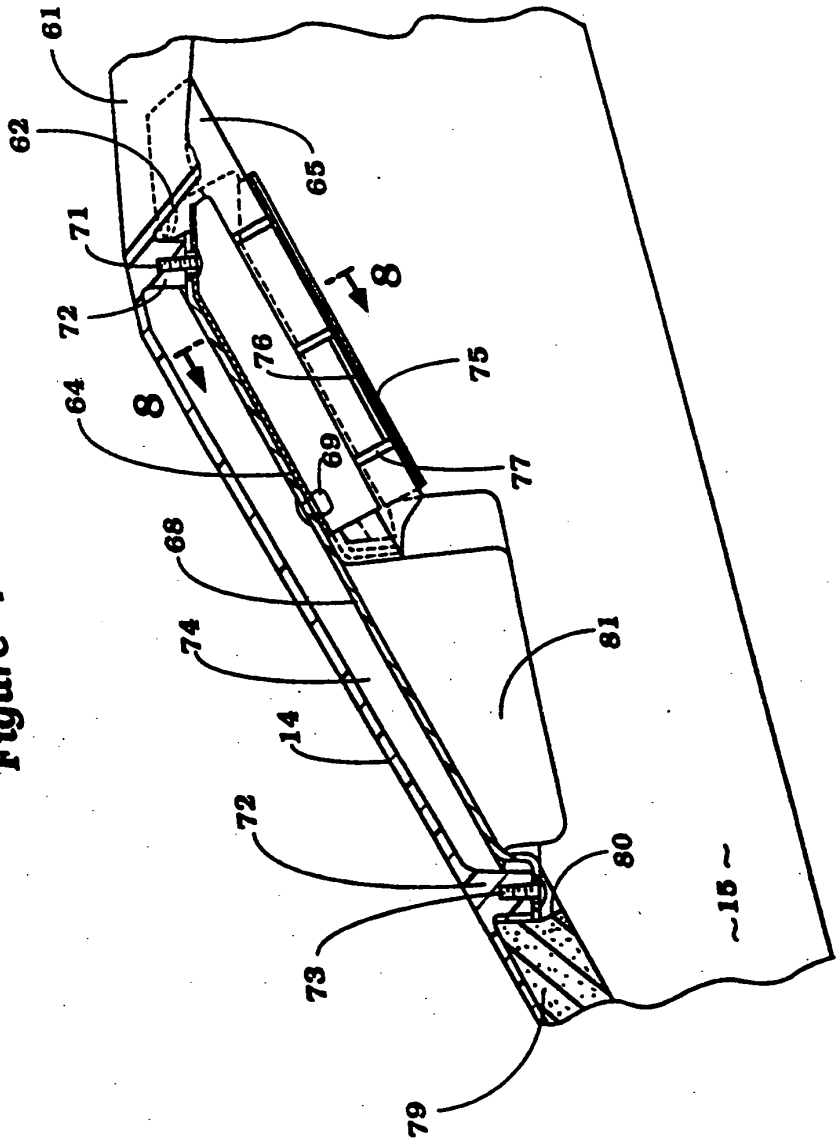

Figure 7

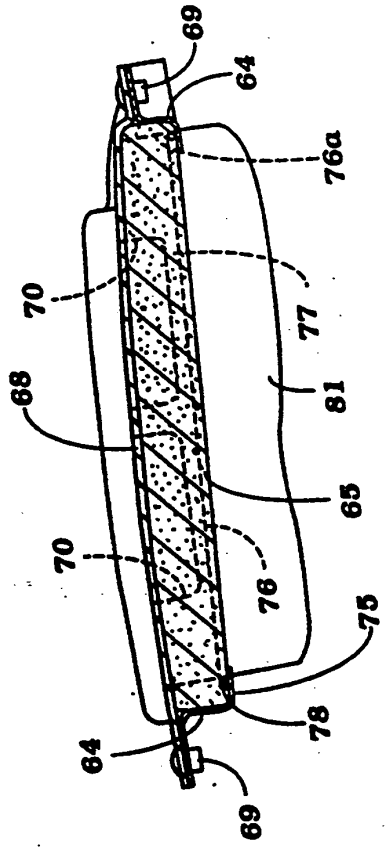

Figure 8

AIR INTAKE SYSTEM FOR SMALL SNOWMOBILE

BACKGROUND OF THE INVENTION

This invention relates to an air intake system for a small snowmobile, and more particularly to an improved construction for providing adequate air flow to the induction system of a small snowmobile which improves the charging efficiency of the intake air and which increases the engine output.

Snowmobiles are highly popular vehicles for both recreational and work purposes in areas where there is a sufficient amount of snow in which to operate them. One type of small snowmobile has been provided which includes an engine compartment formed in its front portion forwardly of the seat and which is enclosed in part by a bottom cover and a top shroud. The engine and its associated components including a carburetor are disposed within this engine compartment, and typically the carburetor is opened within the engine compartment so that it will draw in air which has accumulated within the compartment. An example of such a snowmobile is set forth in Japanese 51-93516.

With this type of arrangement, outside air is introduced into the engine compartment for induction into the carburetor. However, because the engine compartment is enclosed, the heat from the engine and exhaust system components which tends to accumulate within the engine compartment causes the temperature in the engine compartment to be much higher than the temperature outside. Thus, if only this heated air within the engine compartment is inducted into the intake system as has been conventional, the intake air will have a relatively low charging efficiency which, in turn, will decrease the output of the engine.

It is, therefore, a principal object of this invention to provide an improved air intake system for a small snowmobile which reduces or eliminates the above disadvantages.

It is a further object of this invention to provide an improved air intake system for a small snowmobile which employs an opening for drawing in outside air and an intake passage for providing a flow path for this air directly to the engine induction system without accumulating in an engine compartment so as to increase the charging efficiency of the intake air and to increase engine output.

It is yet another object of this invention to provide an air intake system for a small snowmobile wherein outside air flows into the induction system through a filter which is positioned not only to prevent snow from entering the induction system but also to prevent snow from clogging or freezing the filter while still allowing sufficient air flow through it so that the charging efficiency of the intake air and engine output may be increased.

SUMMARY OF THE INVENTION

This invention is adapted to be embodied in an air intake system for a vehicle, preferably a snowmobile, which comprises an internal combustion engine having an induction system. A body is provided which cooperates in defining an engine compartment wherein the engine and induction system are contained. The body has an opening for inducting air from the atmosphere and is in communication with passage means which defines an air flow path from the opening to the induction system so that air flows from the opening to the induction system without accumulating in said engine compartment. A filter element is positioned between the opening and the induction system across the air flow path such that the air flows in a generally upward direction through the filter element.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a small snowmobile constructed in accordance with an embodiment of the invention.

FIG. 2 is a top plan view of the small snowmobile constructed in accordance with an embodiment of the invention.

FIG. 3 is a side view of the body of the snowmobile with portions shown in cross section and other portions broken away.

FIG. 4 is a top plan view of the body of the small snowmobile with portions shown in cross section and other portions broken away.

FIG. 5 is a top view of a portion of the body of the small snowmobile showing the filter bracket assembly.

FIG. 6 is a cross sectional view taken along line 6—6 in FIG. 5.

FIG. 7 is a cross sectional view taken along line 7—7 in FIG. 5.

FIG. 8 is a cross sectional view taken along line 8—8 in FIG. 7.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring first primarily to FIGS. 1, 2, 3 and 4, a small snowmobile constructed in accordance with an embodiment of the invention is identified generally by the reference numeral 10. The small snowmobile 10 is designed to be operated primarily by one or two riders and is of lightweight construction. The snowmobile 10 includes a frame assembly 11 which may be of any known type, but which preferably is formed of an open tubular construction for light weight and high strength. A body 12 which may be formed from molded fiberglass or the like is carried by the frame 11 and includes a bottom cover 13 and a top cover or shroud portion 14 which cooperate to define an engine compartment 15 within which a power unit 16 is contained. The power unit 16 is bolted to the frame 11 with rubber members 17 interposed in between to reduce vibration. The body members 13 and 14 are connected at their forward ends by means of a hinge bracket 18 so that the top shroud 14 may be pivoted about a pivot axis 18a relative to the bottom cover 13 between a closed position as shown in FIG. 3 and an open position wherein the top shroud is pivoted upward so as to provide access to the engine compartment 15.

A seat 19 is supported on the frame 11 and, as previously noted, is adapted to accommodate one or two riders. A pair of foot areas 20 are disposed on opposite sides of the seat 19 and have side panels which extend upwardly from the outer edges thereof. These panels also form part of the body 12. A fuel tank cover 21 overlies a fuel tank 22 which is supported by the frame 11 forwardly of the seat 19. Formed integrally with this fuel tank cover 21 is a cover piece 23 which extends forwardly from the tank cover 21 and cooperates in defining an air intake passage to be described. A pair of plates 24 formed integrally with the cover piece 23

extend downwardly on either side of the fuel tank cover 21 and have louver-type discharge ports 25 formed therein.

A handlebar assembly 26 is carried by the frame 11 forwardly of the seat 19 for steering a pair of skis 27 dirigibly supported by a pair of shock absorbers 28 which are affixed to a transverse frame member 29 that is carried by a pair of down tubes 31 which also form part of the frame assembly 11.

As previously noted, the snowmobile 10 is powered by a power unit 16 which will now be described with particular reference to FIGS. 3 and 4. The power unit 16 is preferably comprised of a two cylinder internal combustion engine which includes a cylinder block 35. The engine drives an engine output shaft that rotates about a horizontally disposed axis extending generally transversely to the longitudinal center line of the snowmobile 10. The output shaft, in turn, drives a crankshaft 36 which is journaled for rotation within a crankcase 37.

The crankshaft 36 drives a transmission which is of the variable speed belt type. In the illustrated embodiment, the transmission includes a drive pulley 38 which is driven by the crankshaft 36 via a centrifugal clutch 39. The drive pulley 38, in turn, drives a driven pulley 41 through a belt 42. The driven pulley 41 is, in turn, coupled in an appropriate manner to a driveshaft 43 for driving a toothed drive belt 44 (see FIG. 1) of the type normally employed for powering such snowmobiles. To this end, there is provided a pair of sprockets 45 drivingly coupled to the driveshaft 43 via a gear assembly 46 and that engage teeth formed on the inner surface of the drive belt 44 for driving it. In addition to the sprockets 45, the drive belt 44 is trained over a pair of rearwardly positioned idler sprockets which are, in turn, journaled on guide rails. The guide rails are suspended relative to the frame assembly 11 by means of trailing arms or links.

The power unit 16 is provided with an induction system that is comprised of an air box or plenum chamber 51 that is positioned over the transmission within the body 12. The air box 51 draws atmospheric air into the engine compartment 15 in a manner to be described and delivers the air to carburetors 52 through a conduit 53. The air box 51 also acts as an intake silencer for the incoming air. The carburetors 52, in turn, discharge a fuel/air mixture into the cylinders of the engine or power unit 16 through an intake manifold 54 affixed to the carburetors 52 by means of couplings 55.

The power unit 16 is also provided with an exhaust system for discharging the exhaust gases from the cylinders of the engine to the atmosphere. This exhaust system includes an exhaust pipe 56, a muffler 57 and a tail pipe affixed to the muffler 57.

Referring now to FIGS. 3 through 8, in accordance with the invention, an air intake opening 61 is provided through the upper portion of the body 12 between an inwardly extending piece 62 of the shroud 14 and the cover piece 23 for inducting air from the atmosphere. Upon entering this opening 61, the air flows into a cavity, indicated by the reference numeral 63, which is positioned upwardly of the cover piece 23 and below a generally disc-shaped filter 65 carried by a supporting fixture 64 that is positioned at the forward end of the cavity 63. The cover piece 23 includes a raised portion 66 with louver-type vent ports 67 above and below through which warm air from the engine compartment 15 travels and mixes with the colder atmospheric air in the cavity 63 so that the induction air will be warmed up to a suitable temperature before being drawn through the filter 65 by the air box 51 of the induction system.

The filter 65 is disposed within the supporting fixture 64 in a generally horizontal manner across the upper forward portion of the cavity 63 such that the air within the cavity 63 is drawn in a generally upward direction through the filter 65. With this construction, the filter 65 not only prevents snow and ice from entering the induction system but also prevents those elements from clogging the filter 65, while still allowing for adequate air flow. Even if some snow or ice adheres to the bottom surface of the filter 65, it will normally fall off as a result of its own weight or it will be melted off by the warmer air coming up through the vents 67 before any clogging or freezing of the filter 65 can occur.

The supporting fixture 64 is mounted to a cowling type surface 68 and extends below an opening 70 formed in the rearward end of the surface 68. The supporting fixture 64 is mounted on either side of the opening 70 at its forward end by a pair of rivets 69 or the like and at either side of its rearward end by a pair of screws 71 or the like. This cowling type surface 68 is positioned inwardly of and in generally parallel relation to the top shroud 14 and is mounted to a pair of bosses 72, extending downwardly from the shroud 14, by the screws 71 and by additional screws 73. This cowling surface 68 acts as an air intake guide and cooperates with the underside of the shroud 14 in defining an air intake passage 74 for the air mixture after it flows through the filter 65 and opening 70.

The supporting fixture 64 includes a pair of filter bracket pieces 75 which extend downwardly from around the opening 70 and then inwardly to define a pair of supporting ledges. A generally S-shaped support member 76 is carried on the ledges of the filter bracket 75 and includes three segments which extend transversely between the opposing ledges. The transversely extending members also extend upwardly to form filter supports 77 upon which the filter 65 is seated, and are interconnected by connecting segment 78. The ends 76a of the support member 76 rest on opposite ledges on opposite ends at a diagonal to one another. The filter 65 rests on the filter supports 77 of the support member 76 and is held in place at its top surface by a portion of the cowling surface 68 which extends both latitudinally and longitudinally across the opening 70, as shown in FIG. 5.

Positioned forwardly of the cowling 68 is a sound absorbing member 79 preferably made of urethane foam which is bonded to the under side of the shroud 14. An inner surface 80 of the sound absorbing member 79 is in close proximity to the forward end of the surface 68 and acts to partition off the forward end of the air intake passage 74 from the engine compartment 15. This member 79 also serves to absorb engine noises.

After the air mixture flows down the air intake passage 74, it is drawn through an opening extending downwardly through the forward portion of the surface 68 which mates with a downwardly extending outlet pipe 81 having an air outlet 82 at its lower end. An intake pipe 83 is affixed to the air box 51 by means of a suitable coupling 84 and has its intake opening positioned below and in general alignment with the air outlet 82 so that the air mixture may flow from the outlet pipe 81 into the intake pipe 83 and then into the air box 51 of the engine induction system.

As a result of this construction and arrangement, colder outside air can be inducted through the opening

61 and supplied to the engine induction system without accumulating in the engine compartment 15 so as to increase the charging efficiency of the intake air. In addition, the filter 65 prevents snow from being sucked into the induction system and is positioned within the air flow path so that it cannot be easily clogged.

In accordance with the invention, however, there is provided a gap 85 between the air outlet 82 and the intake opening of the pipe 83 which allows part of the air mixture to leak out into the engine compartment 15, as shown by the arrows in FIG. 6, so as to cool the engine compartment 15 and to prevent the engine components including the air box 51 and carburetors 52 from overheating. Furthermore, the shroud 14 is formed with inlet ports 86 for providing additional circulation through the interior of the body 12.

It should be noted that the surface 68 and outlet pipe 81 are formed integrally with the shroud 14 and will be pivoted upward when the shroud 14 is opened. However, the gap 85 prevents any contact between the outlet pipe 81 and the intake pipe 83 when the shroud 14 is closed. This gap 85 is also advantageous in that it is able to accommodate minor dimensional errors with respect to the manufacture and assembly of the surface 68 and intake pipe 83.

From the foregoing description, it should be readily apparent that an effective system has been provided for supplying air having a high charging efficiency to the induction system of a snowmobile, while at the same time reducing the likelihood of any snow or ice from entering the induction system. Moreover, it is to be understood that the foregoing description is that of a preferred embodiment of the invention and that various changes and modifications may be made without departing from the spirit and scope of the invention, as defined by the appended claims. For example, although carburetors are employed in the illustrated embodiment, a fuel injection system may be employed instead of the carburetors.

I claim:

1. An air intake system for a vehicle comprising an internal combustion engine having an induction system, a body including a top shroud portion which cooperates in defining an engine compartment wherein said engine and induction system are contained, said body having an opening, formed at least in part by the top shroud portion, for inducting air from the atmosphere, passage means including a cavity in communication with said opening and defining an air flow path from said opening to said induction system so that air flows from said opening to said induction system without accumulating in said engine compartment, and a filter element positioned above said cavity between said opening and said induction system across said air flow path such that the air flows in a generally upward direction through said filter element, and wherein said body comprises vent ports communicating said engine compartment with said cavity so as to enable air within said engine compartment to flow into said cavity and to mix with the air inducted from the atmosphere.

2. An air intake system as recited in claim 1, wherein said passage means comprises an intake passage through which the air flows after flowing through said filter element.

3. An air intake system as recited in claim 2, wherein said passage means further comprises an outlet pipe member having one end connected to said intake passage and the other end defining an outlet opening, and an intake pipe member having one end connected to said induction system and the other end defining an intake opening in proximity to and in communication with said outlet opening so that air flows from said outlet opening into said intake opening, said outlet opening and intake opening being separated by a gap so as to enable some air to flow from said outlet opening into said engine compartment.

4. An air intake system as recited in claim 3, wherein said body comprises a bottom cover and a top cover pivotally connected to said bottom cover for movement between a closed position and an open position wherein said top cover is pivoted upward relative to said bottom cover, said intake passage and outlet pipe member being formed integrally with said top cover.

* * * * *

US005692579A

United States Patent [19]

Peppel et al.

[11] Patent Number: 5,692,579

[45] Date of Patent: Dec. 2, 1997

[54] **ADJUSTABLE SNOWMOBILE TRACK SUSPENSION**

[75] Inventors: **Keith W. Peppel; Robert W. Przekwas; Edwin M. Monsrud**, all of Roseau; **Richard H. Bates, Jr.**, Badger, all of Minn.

[73] Assignee: **Polaris Industries Partners L.P.**, Minneapolis, Minn.

[21] Appl. No.: **356,872**

[22] Filed: **Dec. 14, 1994**

[51] Int. Cl.[6] **B62D 55/104**

[52] U.S. Cl. **180/190**; 180/9.56; 180/9.52; 305/120; 305/127

[58] Field of Search 180/193, 190, 180/9.25, 9.56, 9.5, 9.52, 184; 305/24, 16, 120, 127, 165

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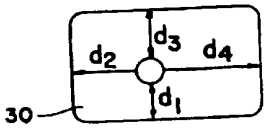
Primary Examiner—Victor E. Johnson

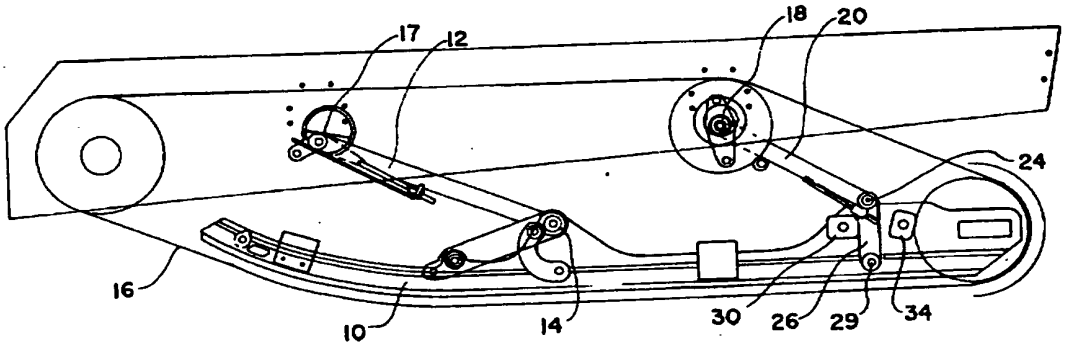
Attorney, Agent, or Firm—Gregory P. Kaihoi

[57] **ABSTRACT**

A suspension system mountable to the chassis of a snowmobile and about which an endless track is carried. The suspension includes a slide frame for engagement with a lower portion of the endless track and one or more springs for urging the slide frame downwardly away from the chassis. The suspension system also includes a downwardly angled suspension arm having an upper end pivotally mounted to the snowmobile chassis. The lower end of the arm is pivotally connected to the slide frame so as to permit limited longitudinal movement of the lower end of the arm with reset to the slide frame. An adjustable limit is provided for adjustably limiting the degree of longitudinal movement of the lower end of the arm with respect to the slide frame to adjustably control the range of orientations of the slide frame with respect to the snowmobile chassis.

23 Claims, 6 Drawing Sheets





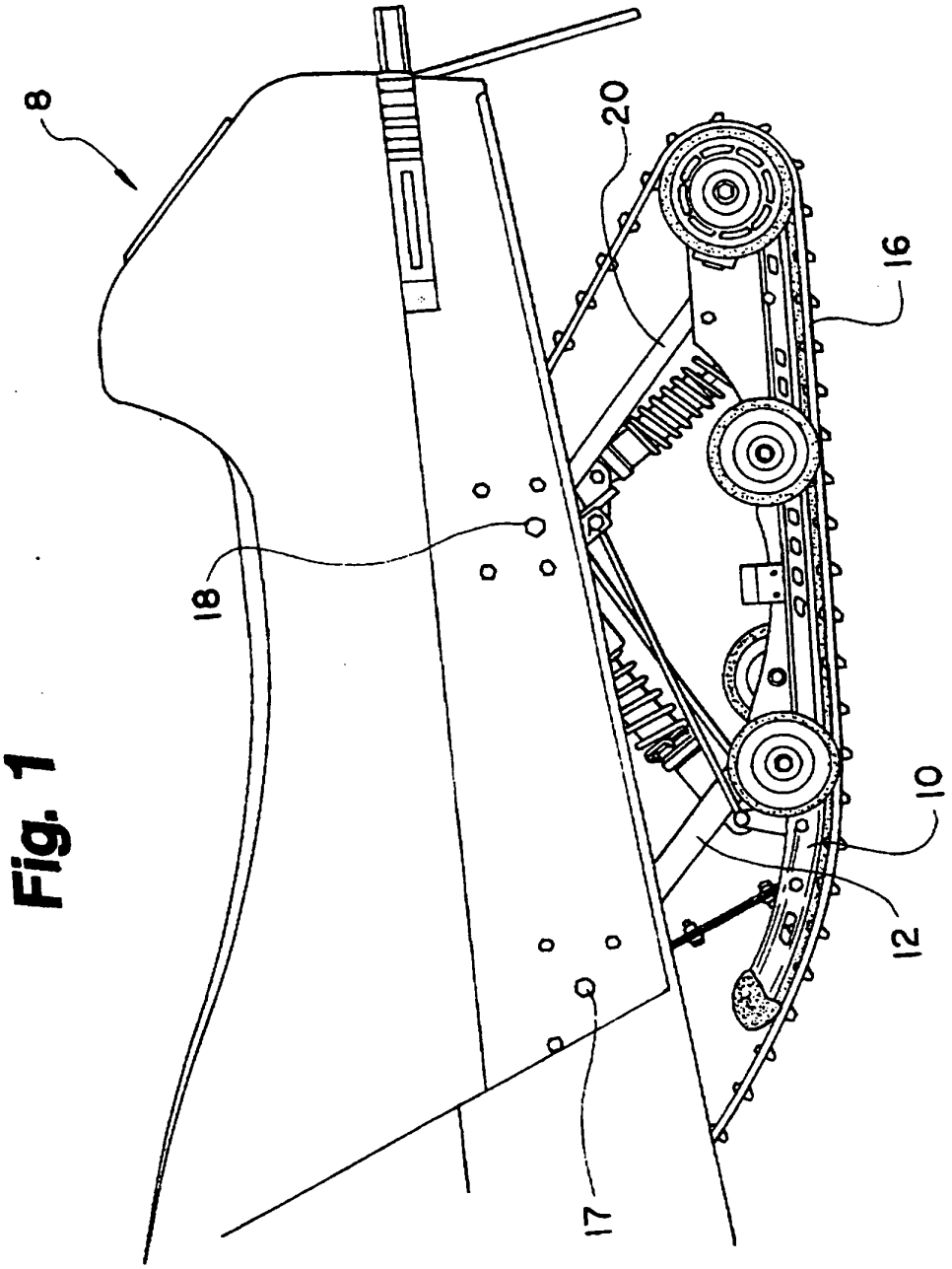
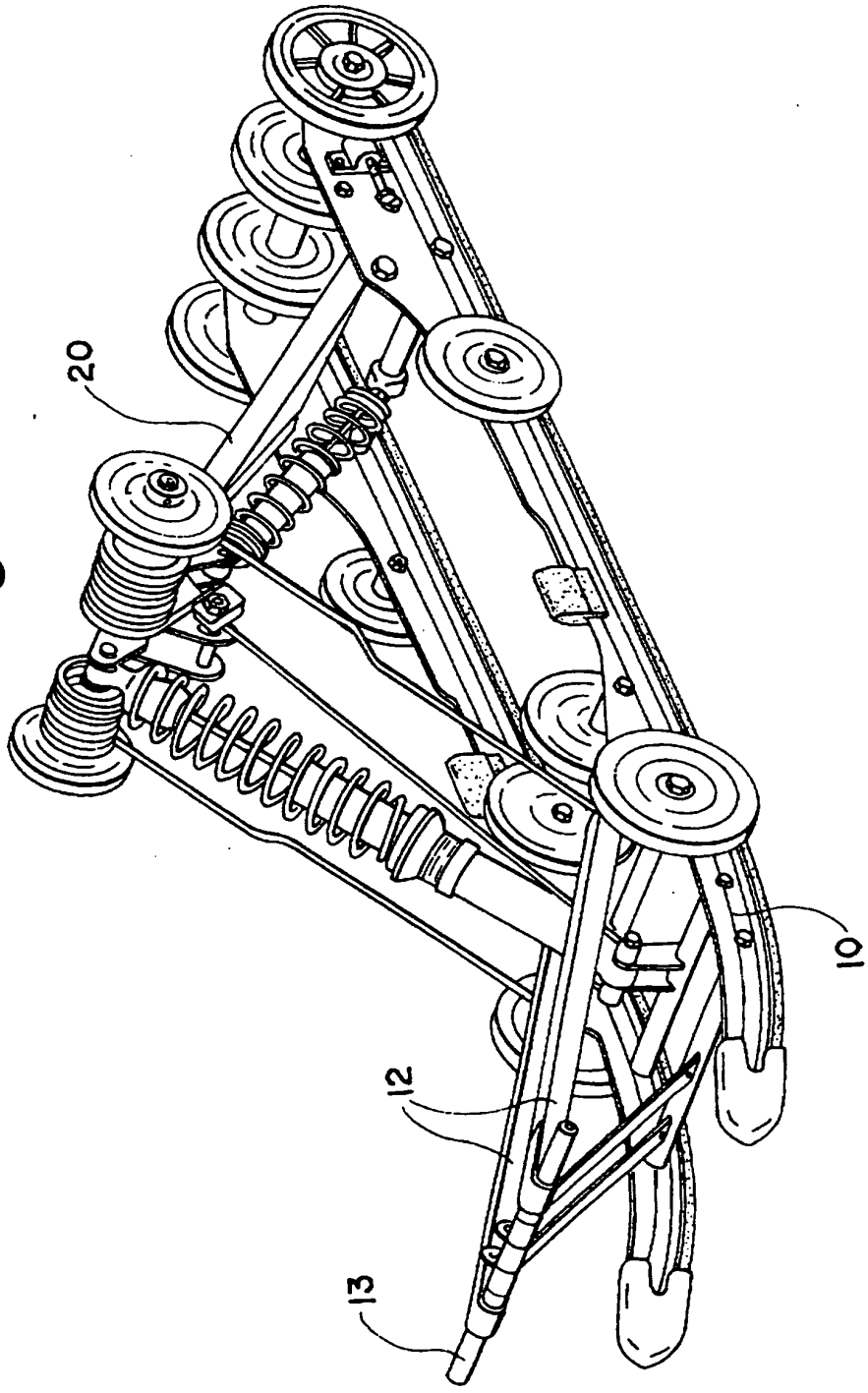


Fig. 1

Fig. 2



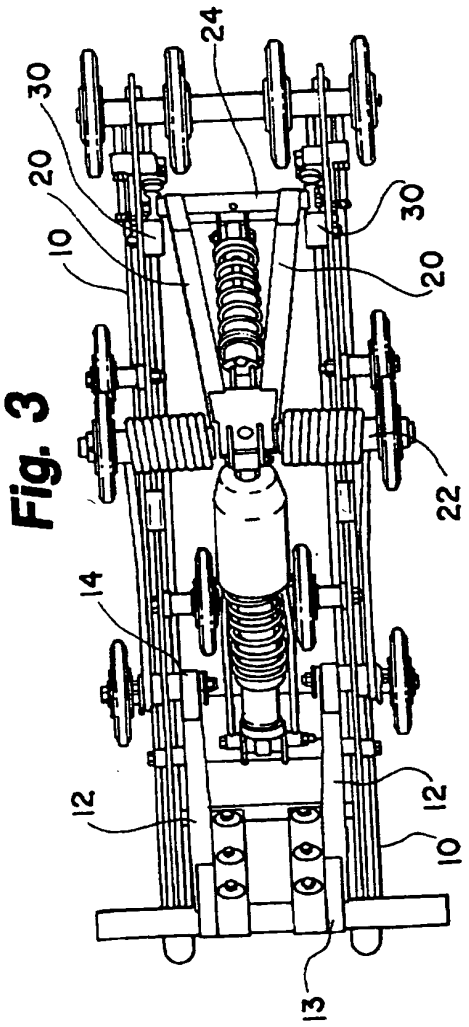


Fig. 3

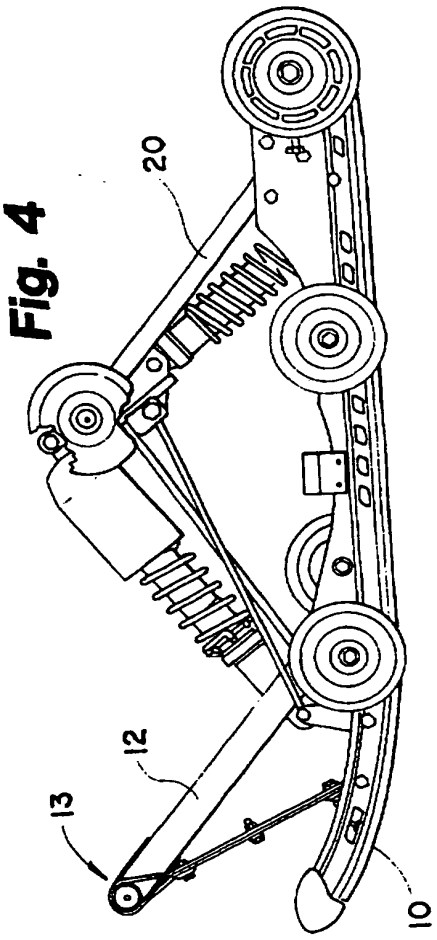


Fig. 4

Fig. 6

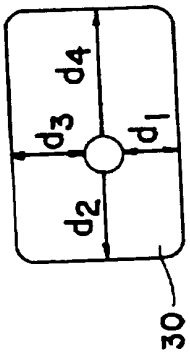


Fig. 5

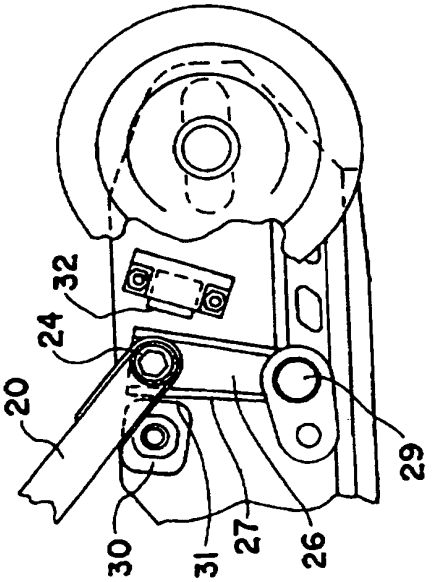
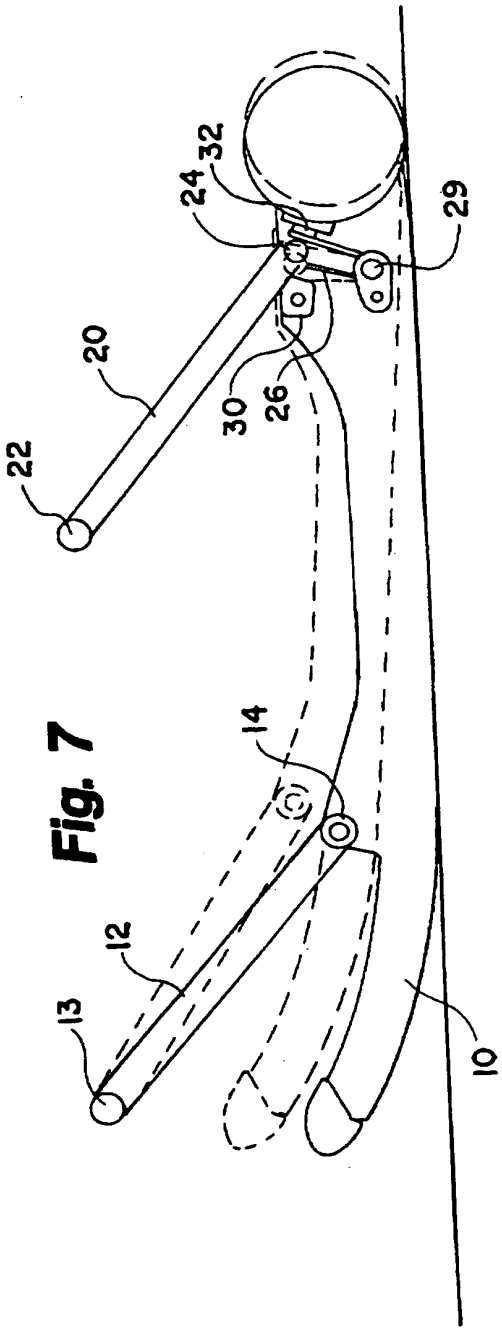


Fig. 7



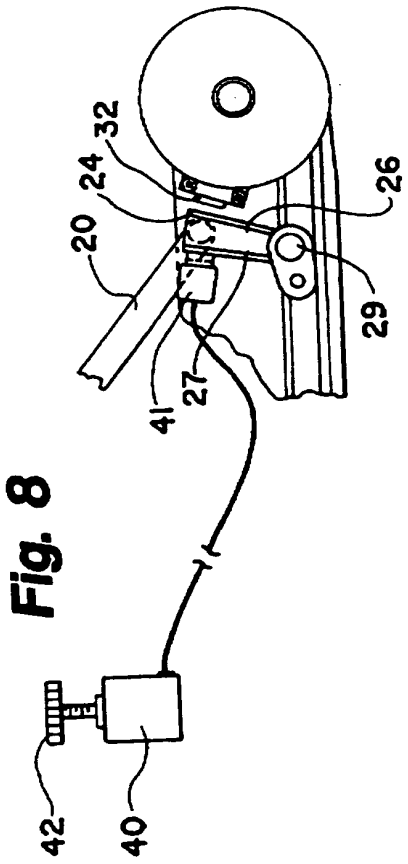


Fig. 8

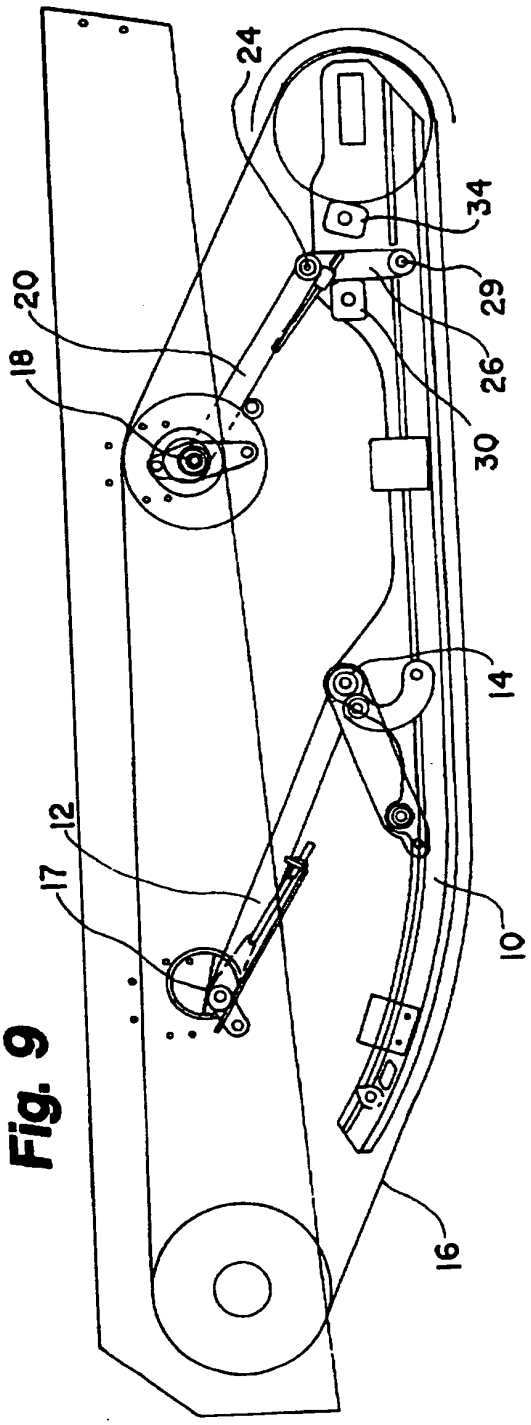


Fig. 9

Fig. 10

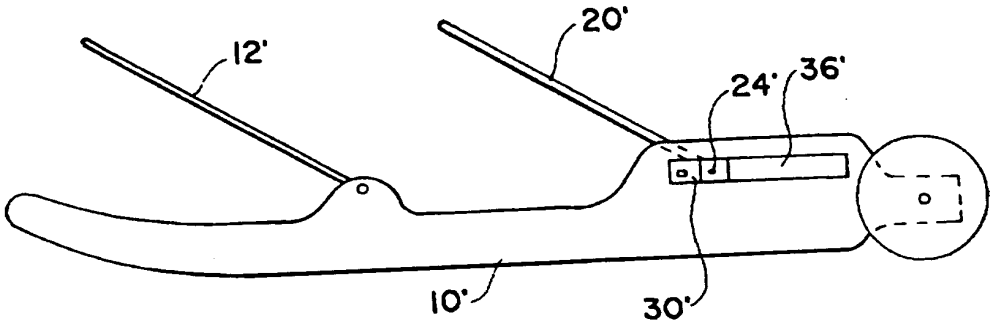
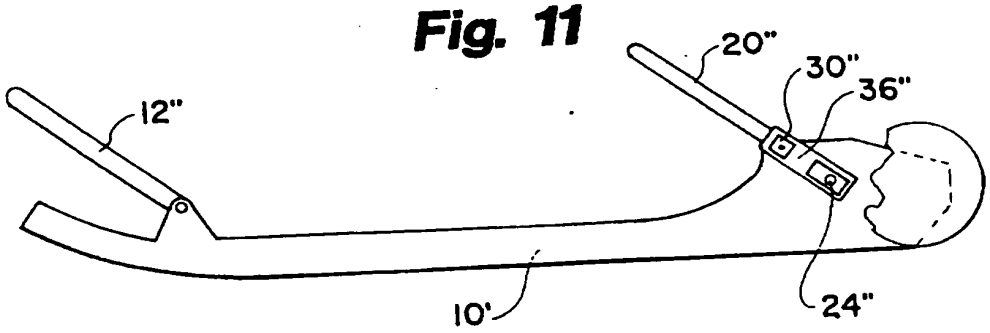


Fig. 11



ADJUSTABLE SNOWMOBILE TRACK SUSPENSION

FIELD OF THE INVENTION

The invention relates to suspension systems for snowmobiles, and in particular to suspensions for snowmobile tracks.

BACKGROUND OF THE INVENTION

Performance characteristics of snowmobiles, including the comfort of the ride, depend upon a variety of systems and components, including the snowmobile suspension. Typically, a snowmobile suspension includes two systems, a front suspension system for the skis and a rear suspension system for the track.

The rear suspension of a snowmobile supports an endless track driven by the snowmobile engine to propel the machine. The track is supported beneath the vehicle chassis by a suspension that is designed to provide a comfortable ride and to help absorb the shock of the snowmobile crossing uneven terrain. Most modern snowmobiles utilize a slide rail suspension which incorporates a pair of slide rails along with several idler wheels to support the track in its configuration. The slide rails typically are suspended beneath the chassis by a pair of suspension arms, each arm being attached at its upper end to the chassis of the snowmobile, and at its lower end to the slide rails. The mechanical linkage of the slide rails to the suspension arms and to the snowmobile chassis typically is provided with springs and one or more (often two) shock absorbers, the springs being loaded to urge the slide rails downwardly away from the snowmobile chassis, and the shocks providing dampening forces for ride comfort.

A variety of configurations of suspension arms, springs, shocks, and shock rods have been utilized to alter the characteristics and feel of the ride given by a particular suspension system. U.S. Pat. No. 5,265,692 (Mallette) shows a snowmobile track suspension having a pair of generally parallel suspension arms connecting the slide rails to the snowmobile chassis. The lower end of the rear suspension arm has a pivot mount that is movable longitudinally of the slide frame. When this pivot is located at its forward most portion of longitudinal movement (i.e., at the forward end of a longitudinal slot), the suspension arms form a parallelogram with the snowmobile chassis and the slide rails so that upward movement of the front suspension arm is transmitted through the slide rails to the rear suspension arm, causing the slide rails to move upward in an orientation that is generally parallel to the snowmobile chassis. Thus, the front end of the slide rails cannot move higher than the back end of the slide rails. The longitudinal slot into which the lower end of the rear suspension arm is pivotally mounted, however, permits the back end of these slide rails to move higher than the front end of the rails. It is said in the Mallette patent that permitting the back end of the slide rails to move upwardly produces a comfortable ride as bumps in the terrain are encountered.

Applicant has found, however, that the Mallette suspension, like many other suspensions, may seem optimized for certain conditions, but performs less optimally in other conditions. For example, in relatively deep powder, it may be particularly desirable to permit the front end of the slide rail suspension to move higher than the rear of the suspension, making it somewhat easier for the snowmobile track to plane out or rise above the powdery snow. Conversely, the amount that the back end of the slide rails

are permitted to rise above the front end of the slide rails (or, to say it a different way, the amount that the snowmobile is permitted to "rock backwards" on the suspension) has an effect on the mount of weight transfer from the front of the machine to the rear of the machine, which affects acceleration and the amount of the weight on the skis (which affects steerability).

In light of the varying characteristics that can be built into a suspension system, a variety of competing suspension systems have been made commercially available, and different types of suspension systems commonly are employed on different types of machines, depending upon their primary usage (e.g., racing, touring, etc.).

SUMMARY OF THE INVENTION

The invention provides a suspension system for a snowmobile track that is adjustable by the rider to match the riding conditions and performance characteristics desired. The system includes a slide frame for engagement with a lower portion of the snowmobile track, and a pair of suspension arms mounted to the snowmobile chassis and the slide frame. Conventional springs are provided for urging the slide frame downwardly away from the chassis. The front suspension arm typically has pivotal connections at both ends, one end connected to the snowmobile chassis and the other end connected to the slide frame. The rear suspension arm is pivotally connected to the snowmobile chassis at its upper end, and includes a pivotal connection at its lower end to the slide frame which permits longitudinal movement of the lower end of this rear suspension arm with respect to the slide frame. Adjustable limit means is provided for adjustably limiting the degree of longitudinal movement of the lower end of the rear arm with respect to the slide frame. Thus, the adjustable limit means can be selectively adjusted by the rider to vary the performance and ride characteristics of the suspension. Preferably the adjustable limit means includes an adjustable limit at either the forward end of longitudinal movement of the suspension arm, or an adjustable limit at the rearward end of travel of the rear suspension arm. In one embodiment, both the forward limit and the rearward limit are adjustable.

In one particularly preferred embodiment, the adjustable limit means comprises an adjuster block eccentrically mounted to the slide frame, the adjuster block being selectively rotatable to one of several positions to selectively vary the limit on movement of the lower end of the rear arm with respect to the slide frame.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the rear portion of a snowmobile suspension of the invention;

FIG. 2 is a perspective view of a rear suspension system of the invention;

FIG. 3 is a top view of the suspension shown in FIG. 2;

FIG. 4 is a side elevational view of the suspension shown in FIG. 2;

FIG. 5 is a broken-away view of the adjustable stop of the invention;

FIG. 6 is a side view of a preferred adjuster block of the invention;

FIG. 7 is a somewhat schematic view of the motion of a suspension slide rail from a first position where the rear suspension arm engages a rear stop and a second position where the rear suspension arm engages an adjustable front stop;

FIG. 8 is a view similar to FIG. 5 showing somewhat schematically the use of a hydraulic adjustment mechanism;

FIG. 9 shows another embodiment having both front and rear adjustable stops;

FIG. 10 shows another type of suspension on which the invention may be utilized; and

FIG. 11 shows yet another type of suspension on which the invention may be utilized.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 depicts the rear portion of a snowmobile 8 having a rear suspension system for supporting the rear portion of the machine and for defining the path of the track 16 which propels the machine across the snow. Although the invention can be utilized in connection with a variety of rear suspension configurations, the invention will be described in the context of a particular preferred rear suspension illustrated in the drawings. Such a suspension includes a front suspension arm 12 and a rear suspension arm 20, each such arm extending downwardly and rearwardly from pivotal connections (17 and 18, respectively) to the snowmobile frame or chassis (often referred to as the "tunnel"). The lower end of each such arm is secured, either directly or indirectly, to the suspension rails 10, beneath which the track slides.

As the snowmobile tunnel obscures much of the mechanical linkages in the rear suspension, FIGS. 2–4 depict the suspension (absent the track) removed from the machine. Springs and shock absorbers are typically provided to urge the slide rails 10 down and away from the snowmobile tunnel, the springs and shocks acting to control the relative movement of the suspension with respect to the tunnel as the snowmobile moves over terrain of varying contours. The relative lengths and orientations of the suspension arms 12 and 20 also control the movement and orientation of the suspension as it is compressed upwardly toward the tunnel.

FIGS. 5 and 7 depict a preferred embodiment for the rear suspension arm mechanism. The upper end 22 of the rear arm 20 is pivotally connected to the snowmobile tunnel. The lower end of the arm 20 includes a pivot point 24 connecting to a lower pivot arm 26, which in turn is pivotally connected to the slide rail 10. As is depicted in FIG. 7, the linkage of the arm 20 with the lower pivot arm 26 permits the front of the rails to rise substantially independently of the rear portion of suspension rails. During this independent movement of the front portion of the suspension, the lower pivot arm pivots from the rearward position shown in solid lines in FIG. 7 to the forward position depicted in broken lines. At the point which the front surface 27 of the lower pivot arm 26 engages the front adjuster block 30, further independent upward movement of the front end of the suspension is prevented. That is, further upward movement of the front of the suspension rails 10 is mechanically linked through the adjuster block 30 to the rear suspension arm 20, causing upward movement of the rear of the suspension (the rate of upward movement of the rear of the suspension may or may not be equal to the rate of movement of the front of the suspension, depending on the specific geometric configuration of the system).

The degree of independent movement afforded to the front of the suspension rails 10 is dependent on the distance between the rear stop 32 and the front adjuster block 30. The rear surface 31 of the front adjuster block 30 thus provides a limit on the relative forward movement of the lower end of the suspension arm 20 with respect to the slide rail 10. The invention provides variability to the position of this limit, thereby giving the rider some control over the performance characteristics of the suspension.

In the embodiment of the invention depicted in FIGS. 5–7, the variability of the limit is accomplished by using a rectangular adjuster block 30. FIG. 6 illustrates the distances (d_1–d_4) between the central mounting hole and the four surfaces of the block; by rotating the block to select one of the surfaces, the position of the limit with respect to the lower end of the suspension arm 20 can be controlled. In FIG. 5, the block is adjusted to its thickest setting; in this setting, the front end of the suspension is permitted relatively less upward movement before the rear of the suspension begins to move upwardly along with the front. If the block were rotated to its thinnest position (i.e., d_1 of FIG. 6), relatively more upward movement of the front of the slide rails is permitted. Thus, the rider can adjust the performance characteristics depending upon the snow conditions and ride characteristics desired. For example, in deeper, powdery snow, it may be desired to permit the front to rise more (assisting the snowmobile in tending to ride up on top of the snow, rather than plowing through it).

Other mechanisms may similarly be used to provide adjustability to the limit on the relative longitudinal movement of the lower end of the suspension arm 20 with respect to the slide rail. For example, FIG. 8 depicts, in somewhat diagrammatic fashion, the use of a hydraulic master cylinder 40, which can be conveniently located near the snowmobile controls, and a slave cylinder 41. By adjusting the master cylinder (as by turning the knob 42), the position of the rearward surface of the slave cylinder 41 can be correspondingly adjusted to change the location of the limit, thereby providing the desired ride characteristics. Though not illustrated, a similar hydraulically adjustable limit could also be provided as the rear limit on relative longitudinal movement of the lower end of the suspension arm 20 with respect to the slide rail. In addition to the adjuster block and hydraulic system, persons of average skill in the art will recognize that other equivalent mechanical stops and/or linkages may be provided that perform the function of providing adjustable limits on the relative longitudinal movement of the lower end of the suspension arm with respect to the slide rail.

FIG. 9 depicts a somewhat different embodiment of the invention, having both front 30 and rear 34 adjuster blocks; the rear adjuster block functions analogously to the front adjuster block, limiting the independent upward movement of the rear of the suspension with respect to the front of the suspension. A hydraulic mechanism similar to that depicted in FIG. 8 could also be used for adjustment of the rear limit. The position and elasticity of the rear limit is valuable, for example, in maintaining proper track tension. In the suspension shown in the drawings, under some circumstances if the rear of the suspension is permitted to rise independently of the front beyond a certain point, the track may become undesirably loose, resulting in slippage of the track with respect to its drive sprocket (i.e., "ratcheting").

FIG. 10 depicts use of the invention in conjunction with a suspension of the type shown in U.S. Pat. No. 5,265,692 (Mallette) (incorporated herein by reference), where the lower end 24' of the rear suspension arm 20' is permitted to travel longitudinally in a slot 36' in the suspension rail 10'. The limit on such forward longitudinal movement can be adjustably controlled by use of an adjustment means of the present invention (such as the adjuster block 30', a hydraulic adjustment mechanism, or other adjustable mechanical connections or limits) on the Mallette-type suspension.

FIG. 11 depicts yet another variation of the type of suspension on which the invention may be utilized. This

suspension is similar to the Mallette suspension, except that the slot 36" is angled upwardly; such a suspension, depicted in U.S. Pat. No. 5,370,198, is commercially available from FAST Incorporated of Ely, Minn., under the trademark M-10. Again, the mechanism of the invention can be added to the M-10 type suspension by positioning the adjustable limit (such as the adjuster block 30") at one or both ends of the upwardly angled slot 36".

In a particularly preferred embodiment the limit on relative longitudinal movement of the lower end of the suspension arm 20 with respect to the slide rail may be constructed to provide resilience. For example, the adjuster block depicted in the drawings preferably is made from an elastomeric material such as a polyurethane. A polyurethane resin obtained commercially from Dow under the trademark PELLATHANE 2102-85A has worked well; it has a hardness of about 85 Shore A. Other equivalent materials would also work well, including materials that are slightly harder.

Other methods of providing resiliency may be utilized, such as utilizing coil compression springs, etc. Resiliency in the adjustable limit assists in absorbing dynamic shock loads encountered by the suspension, and may provide a rising compression rate that can further be used to control the amount of longitudinal forward movement of the lower end of the suspension arm 20 and, therefore, the relative movement of the front of the slide rail with respect to the rear of the slide rail. Thus, for example, as the snowmobile encounters a severe bump at a relatively high speed, the front of the suspension rail will initially begin to rise (as shown in FIG. 7) until the lower pivot arm 26 (or equivalent structural member in analogous suspensions) encounters the adjuster block 30 (or equivalent structure). At this point, if the adjuster block is made of a rigid material, further independent upward movement of the front of the suspension is prevented—the rear of the suspension begins to also move upward (as described above). If the adjuster block (or equivalent structure) is somewhat resilient, however, the resiliency will allow the front to independently move somewhat higher when severe compression forces are encountered. Thus, when the suspension hits a bump particularly hard, the adjuster block will compress further than it would if the same bump were encountered less severely, thereby helping to absorb dynamic shock loads and providing a rising compression rate that gives the front end of the suspension a limited greater degree of independent motion under such loads with respect to the rear of the suspension. In a sense, therefore, the resilient adjustable limit of the suspension is moveable under dynamic loading forces, such movement being in response to and in general proportion to the magnitude of forces causing longitudinal movement of the lower end of the rear arm with respect to the slide frame.

While a preferred embodiment of the present invention has been described, it should be understood that various changes, adaptations and modifications may be made therein without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A suspension system mountable to a chassis of a snowmobile and about which an endless track may be carried, comprising:

a slide frame for engagement with a lower portion of the endless track;

downwardly angled front and rear suspension arms each having an upper end pivotally mountable to the snowmobile chassis, the front arm having a lower end which is pivotally connected to the slide frame;

spring means for urging the slide frame downwardly away from the chassis;

pivotal connection means for pivotally connecting the lower end of the rear arm to the slide frame and permitting limited longitudinal movement of the lower end of the rear arm with respect to the slide frame; and

an adjustable limit mounted to the slide frame to limit the range of longitudinal movement of the lower end of the rear arm with respect to the slide frame.

2. The suspension system of claim 1 wherein the adjustable limit includes means for adjustably limiting the forward movement of the lower end of the rear arm with respect to the slide frame.

3. The suspension system of claim 1 wherein the adjustable limit includes means for adjustably limiting the rearward movement of the lower end of the rear arm with respect to the slide frame.

4. The suspension system of claim 1 wherein the adjustable limit is moveable in response to and in general proportion to the magnitude of forces causing longitudinal movement of the lower end of the rear arm with respect to the slide frame.

5. A suspension system mountable to a chassis of a snowmobile and about which an endless track may be carried, comprising:

a slide frame for engagement with a lower portion of the endless track;

a spring for urging the slide frame downwardly away from the chassis;

a downwardly angled suspension arm having upper and lower ends, the upper end being pivotally mountable to the snowmobile chassis;

pivotal connection means for pivotally connecting the lower end of the arm to the slide frame and permitting limited longitudinal movement of the lower end of the arm with respect to the slide frame; and

an adjustable limit mounted to the slide frame for adjustably limiting the range of longitudinal movement of the lower end of the arm with respect to the slide frame, the adjustable limit comprising an adjuster block mounted to the slide frame, the adjuster block being selectively rotatable to one of several positions to selectively vary the limit of longitudinal movement of the lower end of the arm with respect to the slide frame.

6. The suspension system of claim 5 wherein the adjuster block is made from a compressible material.

7. The suspension system of claim 5 wherein the adjuster block is generally rectangular in shape.

8. A suspension system mountable to a chassis of a snowmobile and about which an endless track may be carried, comprising:

a slide frame for engagement with a lower portion of the endless track;

downwardly angled front and rear suspension arms each having upper and lower ends, the upper ends being pivotally mountable to the snowmobile chassis, the lower end of the front arm being pivotally connected to the slide frame;

a spring for urging the slide frame downwardly away from the chassis;

a pivotal connection for pivotally connecting the lower end of the rear arm to the slide frame and permitting limited longitudinal movement of the lower end of the rear arm with respect to the slide frame; and

a resilient adjustable limit mounted to the slide frame to adjustably limit the range of longitudinal movement of the lower end of the rear arm with respect to the slide frame.

9. A suspension system mountable to a chassis of a snowmobile and about which an endless track may be carried, comprising:

a slide frame for engagement with a lower portion of the endless track;

a spring urging the slide frame downwardly away from the chassis;

a downwardly angled suspension arm having an upper end pivotally mountable to the snowmobile chassis and a lower end pivotally mounted to the slide frame;

the upper end of the arm being connectable to a fixed pivot on the snowmobile chassis, and the lower end being connectable to a movable pivot carried by the slide frame;

the movable pivot being movable from a rearward position, corresponding to a first orientation of the slide frame with respect to the snowmobile chassis, to a forward position corresponding to a second orientation of the slide frame with respect to the snowmobile chassis; and

an adjustable pivot limit mounted to the slide frame to selectively limit the range of movement of the movable pivot to control the range of orientations of the slide frame with respect to the snowmobile chassis.

10. The suspension system of claim 9 wherein the movable pivot is disposed in a slot in the slide frame.

11. The suspension system of claim 10 wherein the slot is oriented generally horizontally.

12. The suspension system of claim 10 wherein the slot is angled upwardly.

13. A suspension system mountable to a chassis of a snowmobile and about which an endless track may be carried, comprising:

a slide frame for engagement with a lower portion of the endless track;

downwardly angled front and rear suspension arms each having an upper end pivotally mountable to the snowmobile chassis and a lower end pivotally mounted to the slide frame;

spring means for urging the slide frame downwardly away from the chassis;

the upper end of the rear arm being connectable to a fixed pivot on the snowmobile chassis, and the lower end being pivotally connected to a movable pivot carried by the slide frame;

the movable pivot being movable from a rearward position, corresponding to a first orientation of the slide frame with respect to the snowmobile chassis, to a forward position corresponding to a second orientation of the slide frame with respect to the snowmobile chassis; and

adjustable pivot limit means mounted to the slide frame for selectively limiting the range of forward movement of the movable pivot to control the range of orientations of the slide frame with respect to the snowmobile chassis.

14. A suspension system mountable to a chassis of a snowmobile and about which an endless track may be carried, comprising:

a slide frame for engagement with a lower portion of the endless track;

a spring mounted to urge the slide frame downwardly away from the chassis;

a downwardly angled suspension arm having upper and lower ends, the upper end being pivotally mountable to the snowmobile chassis;

a pivotal connector pivotally connecting the lower end of the arm to the slide frame and permitting limited longitudinal movement of the lower end of the arm with respect to the slide frame; and

an adjustable limit mounted to the slide frame adjustably limiting the range of longitudinal movement of the lower end of the arm with respect to the slide frame.

15. A suspension system mountable to a chassis of a snowmobile and about which an endless track may be carried, comprising:

a slide frame for engagement with a lower portion of the endless track;

a suspension arm having upper and lower ends, the upper end being pivotally mountable to the snowmobile chassis;

a pivot arm having upper and lower ends, the upper end of the pivot arm being pivotably connected to the lower end of the suspension arm to permit relative pivotal movement about a generally transverse axis, and the lower end of the pivot arm being pivotally connected to the slide frame, permitting the upper end of the pivot arm to pivot through a range of motion;

an adjustable limit mounted to the slide frame to define a limit on the range of motion through which the pivot arm pivots.

16. The suspension system of claim 15 wherein the adjustable limit is positioned to adjustably limit forward pivotal movement of the pivot arm.

17. The suspension system of claim 15 wherein the adjustable limit is positioned to adjustably limit rearward pivotal movement of the pivot arm.

18. The suspension system of claim 15 including a second adjustable limit, said adjustable limits positioned to adjustably limit forward and rearward pivotal movement of the pivot arm.

19. The suspension system of claim 15 wherein the adjustable limit is movable from a first position corresponding to a first range of motion of the pivot arm to a second position corresponding to a second, shorter range of motion of the pivot arm.

20. The suspension system of claim 15 wherein the adjustable limit is resilient.

21. The suspension system of claim 20 wherein the adjustable limit includes a hydraulic cylinder mounted to selectively vary the limit on pivotal movement of the pivot arm with respect to the slide frame.

22. The suspension system of claim 18 wherein the adjustable limit is positioned to define a forward end of pivotal movement of the pivot arm with respect to the slide frame, the limit having at least first and second positions, the forward end of pivotal movement being positioned farther forward when the limit is in its first position than when it is in its second position.

23. The suspension system of claim 15 wherein the adjustable limit is positioned to define a rearward end of pivotal movement of the pivot arm with respect to the slide frame, the limit having at least first and second positions, said rearward end of pivotal movement being positioned farther rearward when the limit is in its first position than when it is in its second position.

* * * * *

US005355826A

United States Patent [19]

Hattori et al.

[11] Patent Number: 5,355,826

[45] Date of Patent: Oct. 18, 1994

[54] WATERCRAFT

[75] Inventors: Toshiyuki Hattori; Fumihiko Ebihara, both of Shingai-Iwata, Japan

[73] Assignee: Yamaha Hatsudoki Kabushiki Kaisha, Iwata, Japan

[21] Appl. No.: 79,899

[22] Filed: Jun. 21, 1993

Related U.S. Application Data

[62] Division of Ser. No. 786,536, Nov. 1, 1991, Pat. No. 5,255,626.

[30] Foreign Application Priority Data

Oct. 9, 1991 [JP] Japan 3-262355

[51] Int. Cl.[5] B63B 1/20

[52] U.S. Cl. 114/270; 114/362; 114/363

[58] Field of Search 114/270, 362, 363

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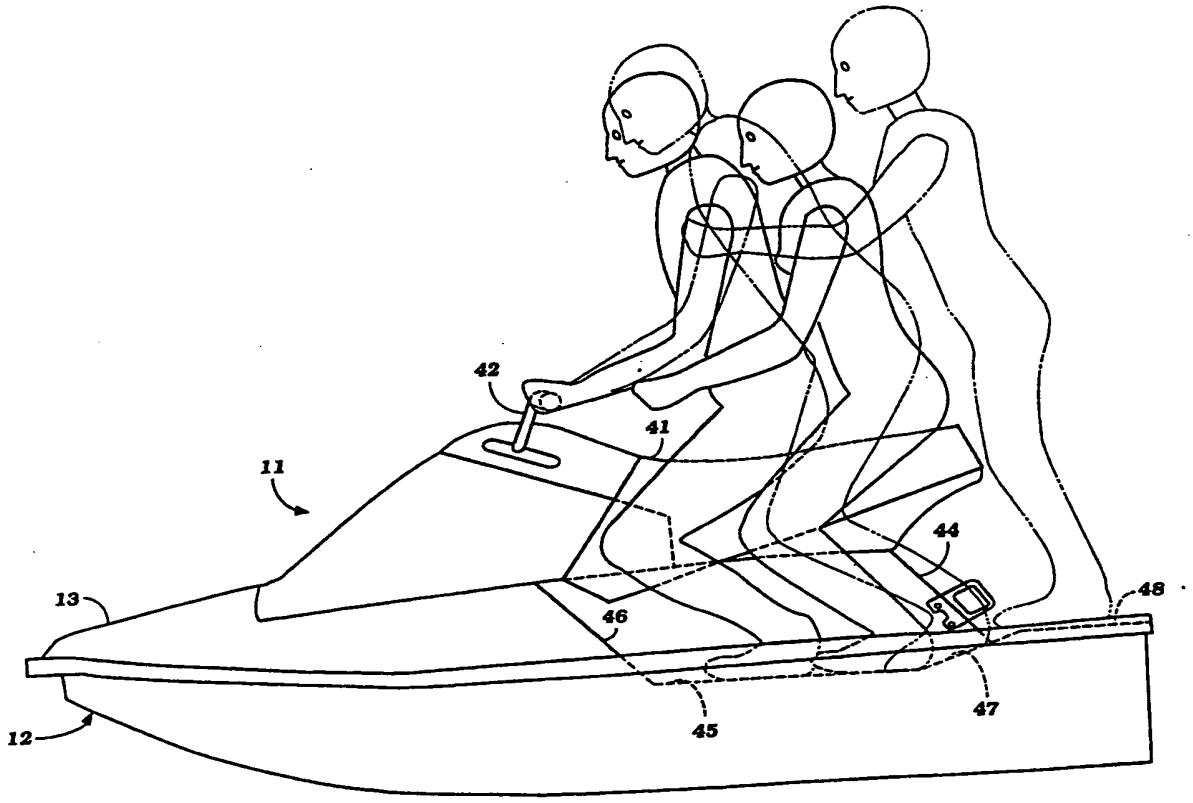
Primary Examiner—Sherman Basinger
Attorney, Agent, or Firm—Knobbe, Martens, Olson & Bear

[57] ABSTRACT

A small watercraft adapted to seat one or more riders in motorcycle fashion and which has a hull configured so as to facilitate leaning without capsizing. The foot area for the riders is such that a rider may either sit on the seat in straddle fashion or stand behind the seat and may move between these positions easily and while the watercraft is in motion.

13 Claims, 7 Drawing Sheets



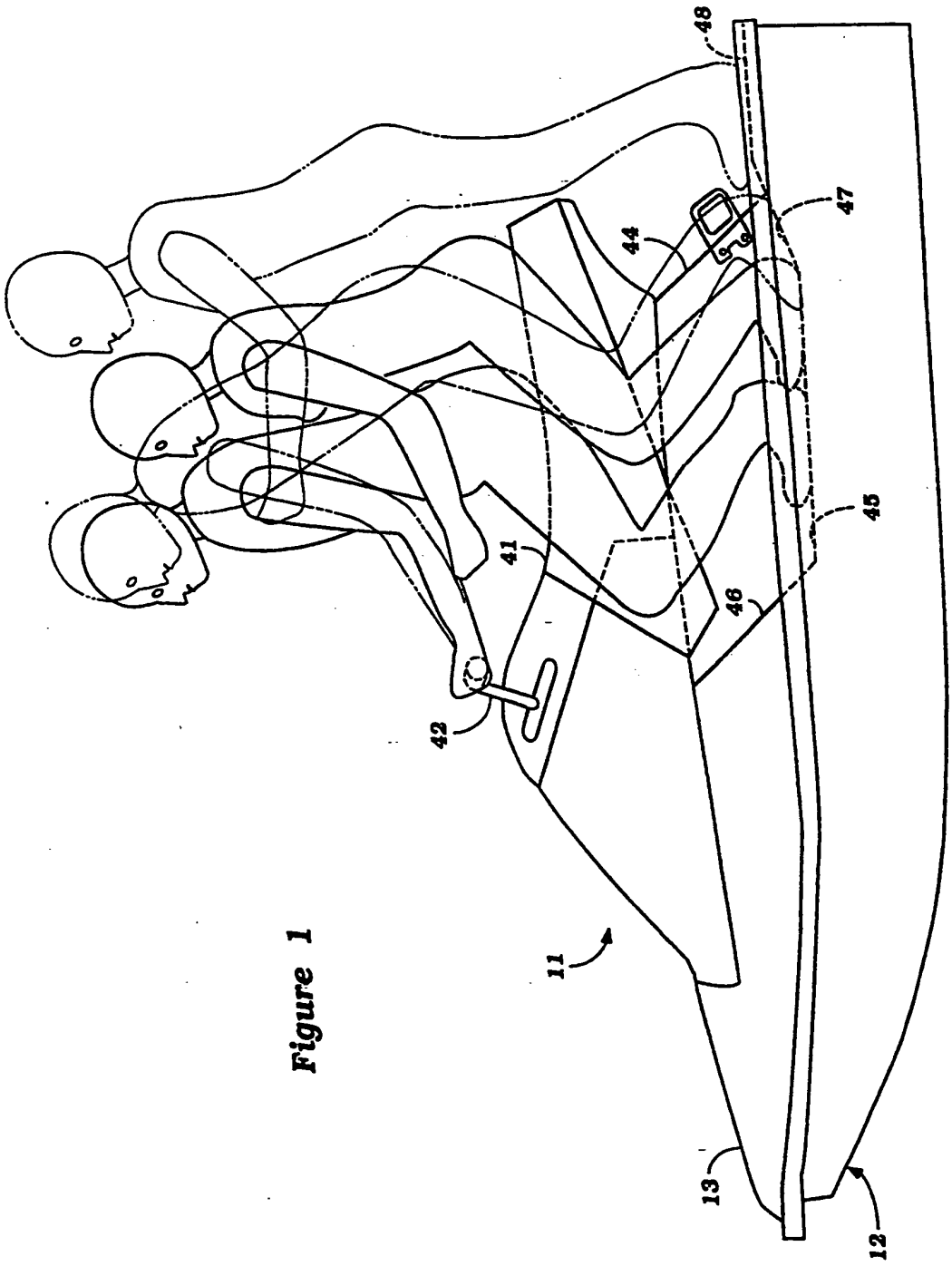


Figure 1

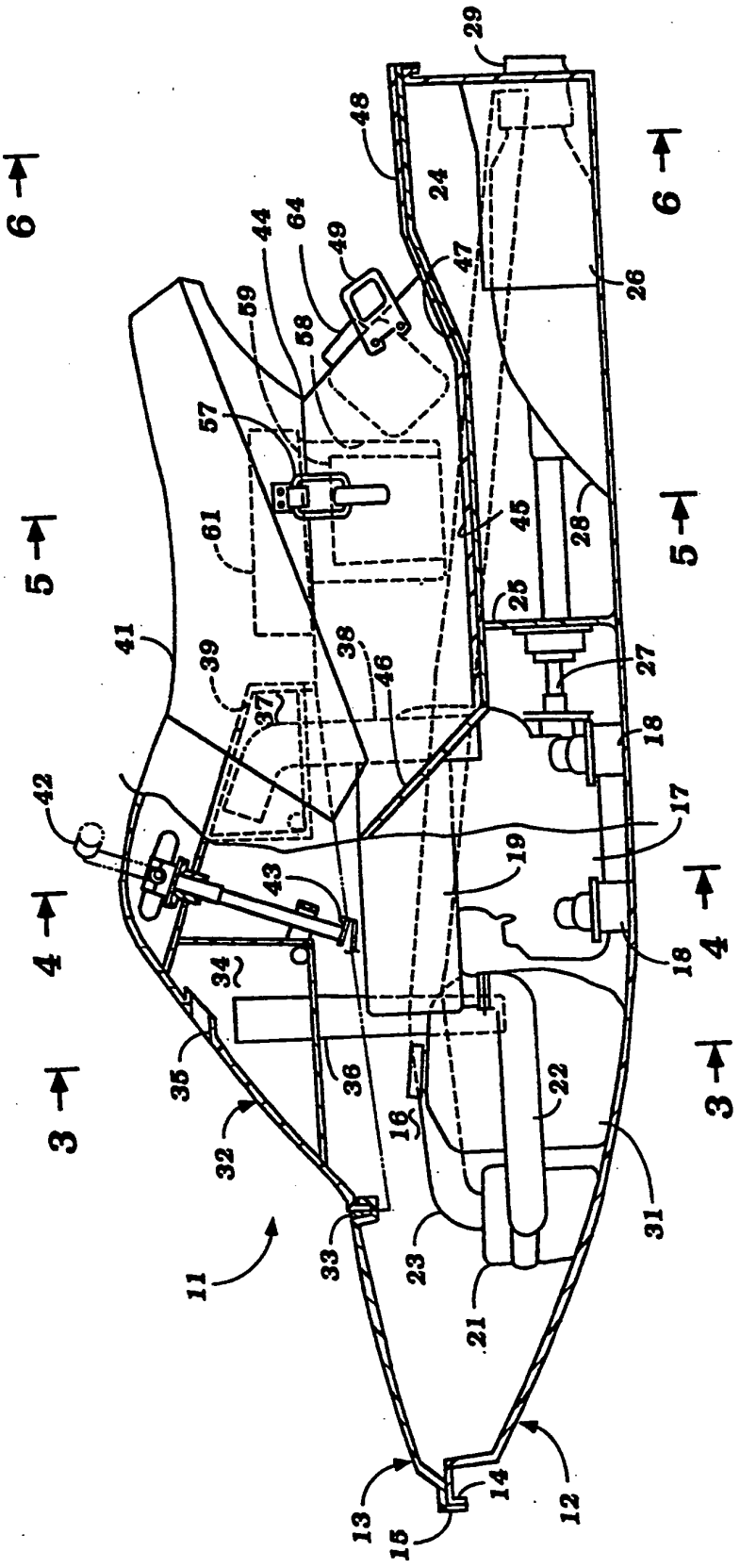

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Figure 2

Figure 3

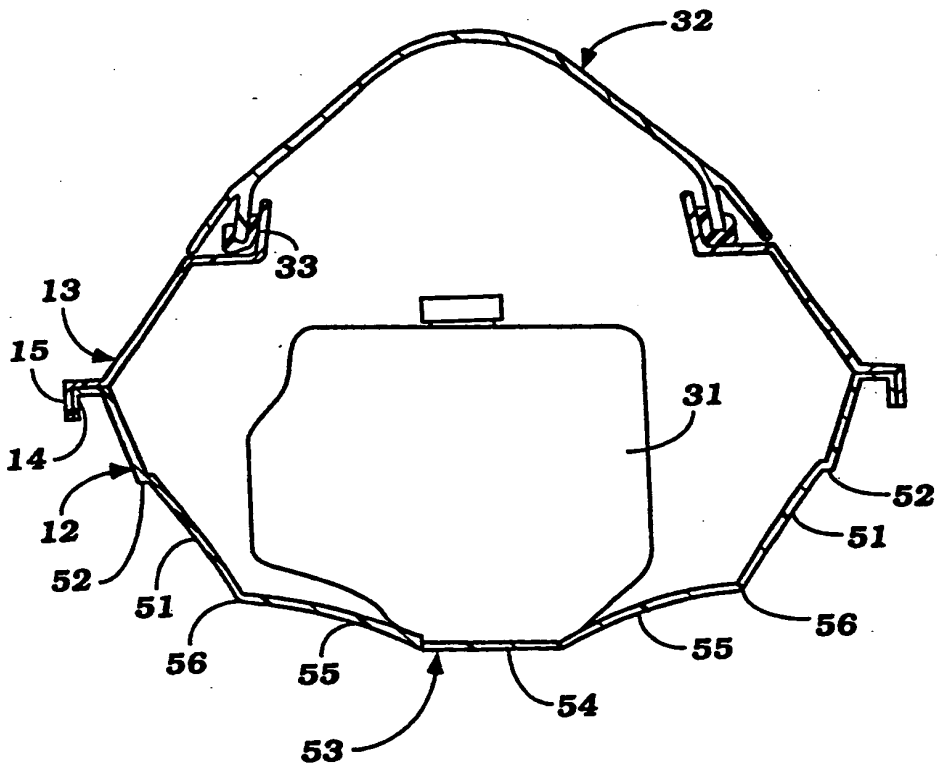
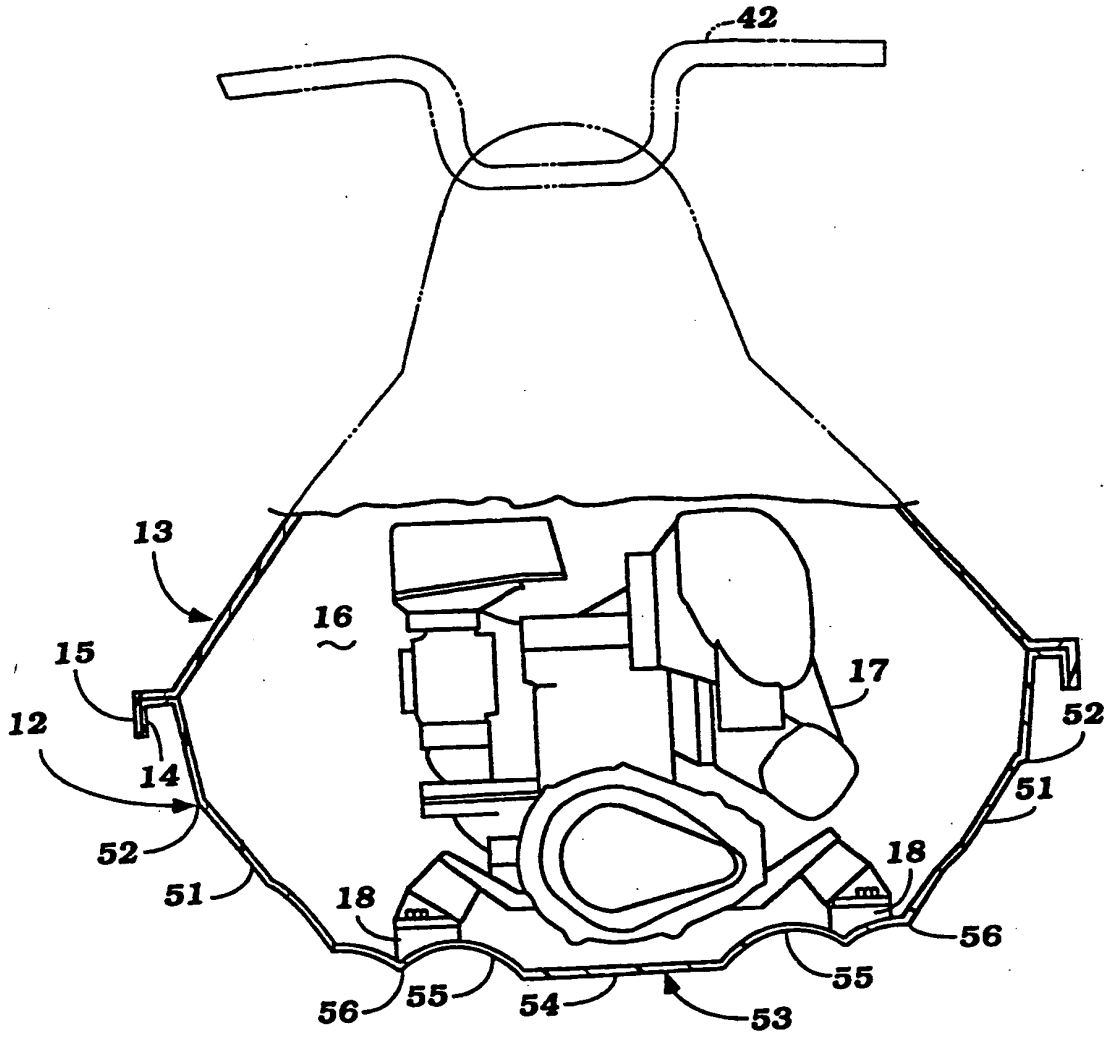


Figure 4



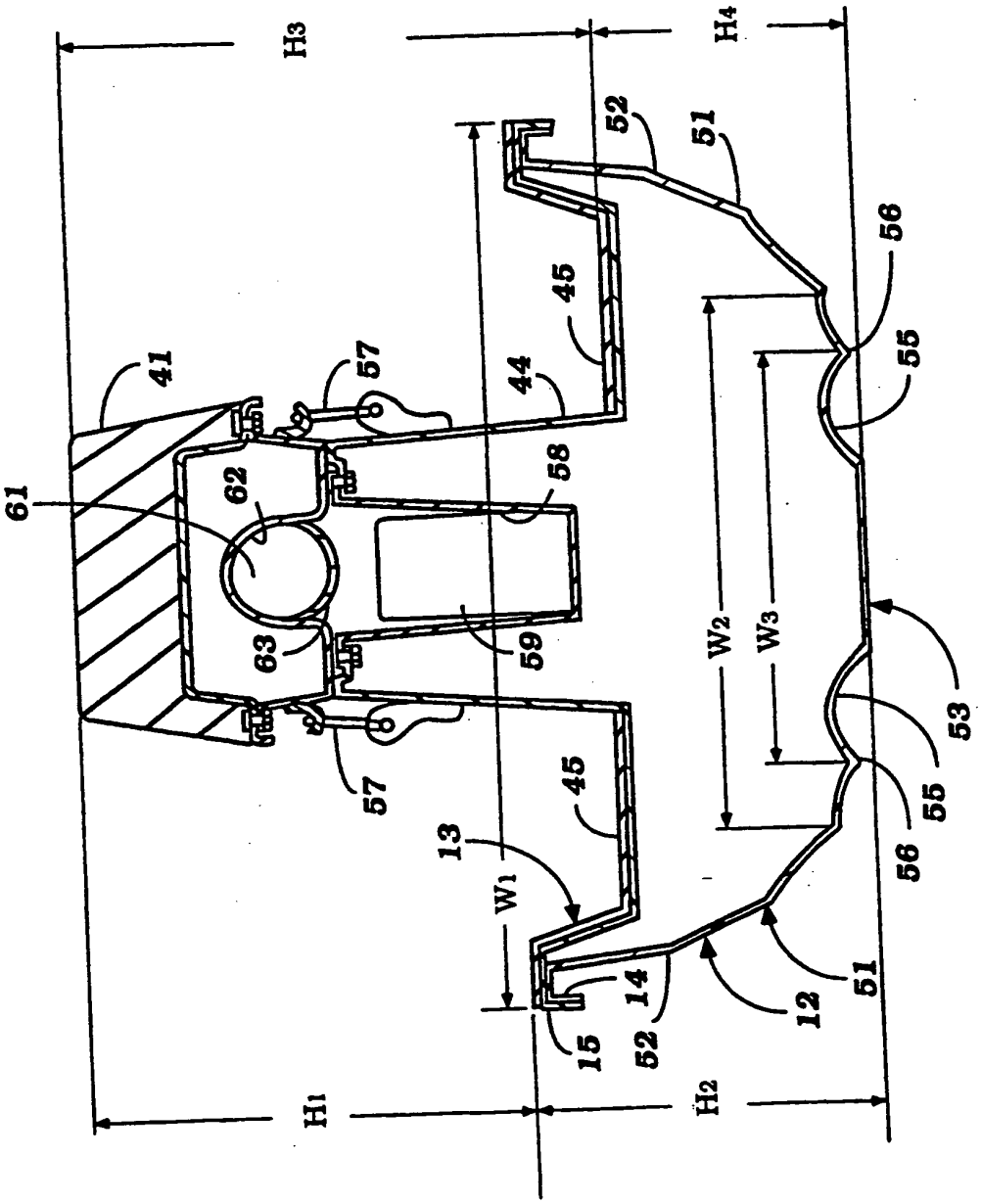

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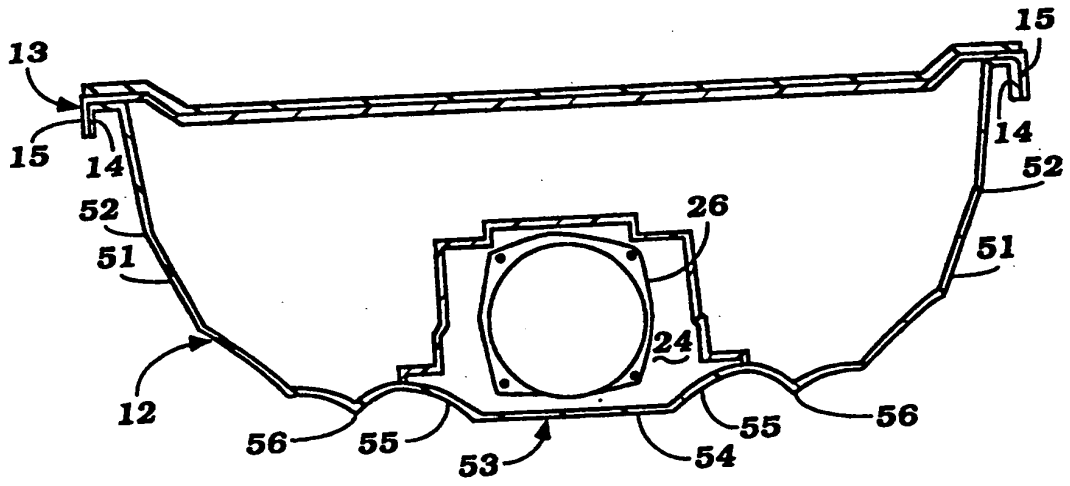
Figure 5

Figure 6



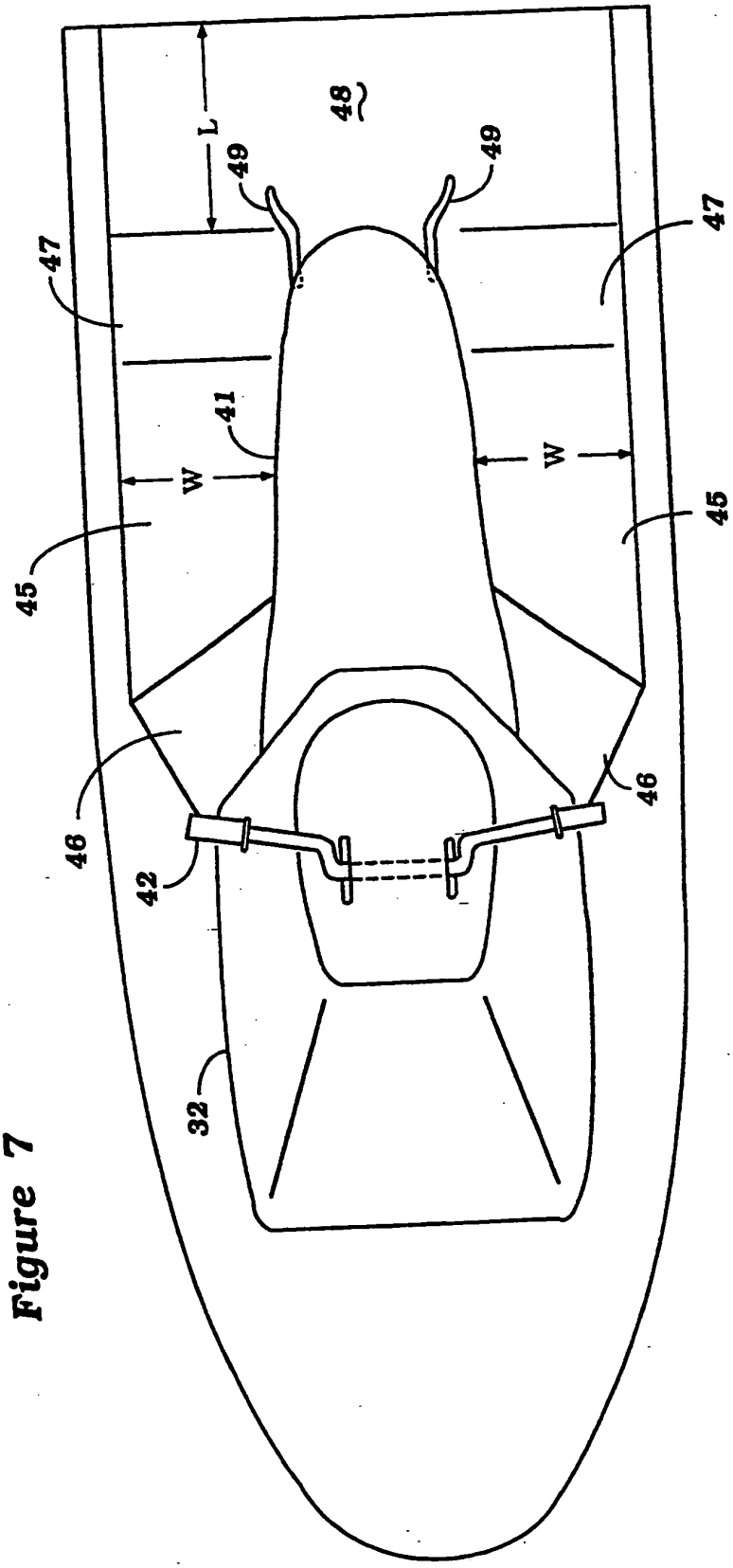


Figure 7

WATERCRAFT

CROSS-REFERENCE TO RELATED APPLICATION

This application is a division of our co-pending application Ser. No. 786,536, filed Nov. 1, 1991, entitled "Watercraft," now issued as U.S. Pat. No. 5,255,626 on Oct. 26, 1993.

BACKGROUND OF THE INVENTION

This invention relates to a watercraft and more particularly to an improved sporting type of watercraft which is also capable of utilitarian use.

There are a wide variety of propelled type of watercraft each of which is designed primarily for a single purpose. Recently there has been a large variety of jet propelled type of small watercraft proposed that also are designed primarily for different purposes. One of these types of watercraft is primarily sporting in nature and is designed so as to be operated by the rider standing on the watercraft. Other types of watercraft try to emulate this sporting characteristic but are more utilitarian in nature and the rider operates the watercraft seated in a straddle fashion.

There also have been proposed types of watercraft which are similar to motorcycles and operate on floats or skis. However, by their very nature these watercraft, although they resemble a motorcycle, are not ridden like a motorcycle. That is, this type of watercraft does not permit the operator to control the motion of the watercraft by leaning as can be done with a motorcycle.

It is, therefore, a principal object of this invention to provide a small watercraft which can be ridden like a motorcycle and in which the operator may lean the watercraft for handling or other purposes.

It is a further object of this invention to provide a small watercraft of the type that can be ridden like a motorcycle and which can be leaned by the rider.

Although it is desirable to permit the rider to lean the watercraft for maneuvering or other purposes, if the hull is designed so as to facilitate this operation, then the hull also may be prone to capsize quite easily. In fact, many watercraft are designed so that this can happen and the hull is self righting. However, for an inexperienced or certain types of riders it is desirable to insure that the hull will not capsize even though it may be leaned.

It is, therefore, a still further object of this invention to provide an improved hull construction for a small watercraft which permits the hull to be leaned but which will resist capsizing.

As has been noted, many of the small watercraft and particularly those designed primarily or solely for sporting use, are intended to be operated by only a single rider. However, the utility and enjoyment of the watercraft can be expanded if the rider has the capability of carrying one or more passengers. However, when this is done the sporting nature of the watercraft may be lost. Furthermore, it is desirable to permit the rider and or his passengers to assume different postures on the watercraft for different purposes. For example, it may be desirable to permit both occupants to be seated for long distance cruising and/or one or both of the occupants to operate in a standing position. However, the hull construction should be such so as to permit the occupants of the watercraft to easily move from one

position or posture to another without losing their footing.

It is, therefore, a still further object of this invention to provide an improved hull configuration for a small watercraft that permits the rider to accommodate an additional passenger and which also permits the rider or passenger to assume different postures on the watercraft safely and while the watercraft is in motion.

SUMMARY OF THE INVENTION

A first feature of this invention is adapted to be embodied in a watercraft having a hull defining a deck area with a seat supported on the deck area at a substantial distance there above for accommodating for a rider seated thereon in straddle fashion with the rider's knees being bent but in a generally standing posture. Control means are provided for the watercraft forwardly of the seat and accessible by a rider on the seat.

Another feature of the invention is adapted to be embodied in a hull for a small watercraft which facilitates leaning of the hull like a motorcycle when turning and which will resist capsizing. The hull has a pair of widely spaced-gunnels that extend along its outer side for providing buoyancy and for limiting the amount of leaning. A pair of generally downwardly converging side sections each extend from a respective gunnel to a lower hull area. The lower hull area has a generally flat portion which is substantially narrower in width than the gunnels.

Yet another feature of the invention is adapted to be embodied in the deck configuration for the hull of a small watercraft. The deck has a seat disposed generally centrally thereon and extending along a portion of the length. On opposite sides of the seat there are provided foot areas which extend rearwardly and there is unincumbered transversely extending foot area disposed in a rear deck positioned behind the seat which has a length that is greater than the width of the individual side foot areas. The side foot areas have an upwardly inclined rear portion that merges into the rear deck.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a small watercraft constructed in accordance with an embodiment of the invention and showing the driver and a single passenger both seated and standing in solid and phantom lines, respectively.

FIG. 2 is a side elevational view of the watercraft, with portions broken away so as to more clearly show the construction.

FIG. 3 is a cross sectional view taken along the line 3—3 of FIG. 2.

FIG. 4 is a cross sectional view taken along the line 4—4 of FIG. 2.

FIG. 5 is a cross sectional view taken along the line 5—5 of FIG. 2.

FIG. 6 is a cross sectional view taken along the line 6—6 of FIG. 2.

FIG. 7 is a top plan view of the watercraft.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring now in detail to the drawings, the reference numeral 11 designates a small watercraft constructed in accordance with an embodiment of the invention. The watercraft 11 is comprised of a hull assembly made up of a lower hull portion 12 and an upper deck portion 13.

The hull portion 12 and deck portion 13 are formed from a suitable material such as a molded fiberglass reinforced resinous plastic or the like. The hull and deck portions 12 and 13 have interlocking flanges 14 and 15, respectively, which extend outwardly and define a gunnel extending around the outer periphery of the watercraft as clearly shown in the figures.

An engine compartment, indicated generally by the reference numeral 16 is formed centrally of and at the forward position of the hull and specifically primarily by the lower hull portion 12. An internal combustion engine 17 of any known type is mounted within the engine compartment 16 on engine mounts 18.

The engine 17, although it may be of any known type, has an exhaust manifold 19 which receives exhaust gases from the engine 17 and also water from its cooling jacket. The exhaust manifold 19 communicates with a water trap and silencing device 21 that is positioned forwardly within the engine compartment through an exhaust pipe 22. The water trap and silencing portion 21 has a discharge exhaust tail pipe 23 that extends rearwardly and which terminates with a tunnel 24 formed rearwardly of the engine compartment 16 and which is defined by a vertically extending bulkhead 25.

A jet propulsion unit, indicated generally by the reference numeral 26 is positioned within the tunnel 24 rearwardly of the bulkhead 25. An output shaft 27 of the engine 17 extends through the bulkhead 25 and is coupled to an impeller shaft of the jet propulsion unit 26 for drawing water through a downwardly facing water inlet portion 28 and discharging it through a pivotal steering nozzle 29 in a well known manner.

A fuel tank 31 for the engine 17 is positioned forwardly of the engine 17 and between the engine 17 and the water trap and silencing device 21. The fuel tank 31, water trap and silencing device 21 and engine 17 are disposed so that their masses will lie substantially on a longitudinally extending center plane of the watercraft 11 for balance purposes. Further details of the construction of the engine 17 and its ancillary components and the jet propulsion unit 26 is not believed to be necessary to enable those skilled in the art to practice the invention. For that reason, further details of the construction and operation of these components is not believed to be necessary.

The engine 17 and fuel tank 31 are accessible through a removable hatch cover 32 which engages a peripheral seal 33 carried by the deck portion 13 so as to provide a water tight seal. An air inlet cavity 34 is formed by the hatch cover 32 and atmospheric air can enter this cavity 34 through an atmospheric air inlet 35. A vertically extending vent pipe 36 extends downwardly from the cavity 34 into the engine compartment 16 so as to provide ventilating air to the engine compartment 16 and also air for induction into the engine 17 for its operation.

An exhaust air cavity 37 is also formed by the hatch cover 32 rearwardly of the inlet cavity 34. An L shaped ventilating air exhaust pipe 38 is disposed near the rear of the engine 17 and extends into the exhaust cavity 37. An exhaust air outlet 39 is formed in the upper portion of the cavity 37 and communicates with an area now to be described.

The area is enclosed by a seat 41 that is affixed to the deck portion 13 rearwardly of the hatch cover 32 and which may partially overlie the hatch cover 32. The seat 41 is formed from a suitable cushioning-and slip resistent material and has its seating surface configured so that a driver and passenger may sit upon the seat as shown in FIG. 1 in a somewhat straddle fashion much like on a motorcycle. When so seated, the driver and passenger, as shown in FIG. 1 in solid lines, have their knees in a bent position similar to that of a rider of a motorcycle so that they are in a semi-standing posture. The seat is inclined upwardly in a rearward direction to provide a higher seating position progressing toward the rear of the watercraft 11. This permits the rearwardly position rider to see over the driver's shoulders and also permits the driver to increase his heighth or move to a standing position by moving rearwardly along the seat 41.

The seat and specifically its slip resistent material extends down along the sides and forwardly so that the rider and passengers may grip the seat with their knees so as to afford stability.

A handle bar assembly 42 is positioned forwardly of the seat 41 and on substantially the same height as it so that the forward most rider may operate a steering mechanism for steering the discharge nozzle 29 in a known manner, which includes a flexible transmitter having a connection to a lever arm 43 fixed to the lower end of the handlebar 42. Other controls such as throttle control, engine kill switch, etc may be positioned forwardly of the seat 41 in proximity to or on the handlebar assembly 42.

The seat 41 is supported on a raised pedestal 44 of the deck portion which is surrounded by a pair of depressed foot areas 45 as best seen in FIGS. 5 and 7 which foot areas may be covered with a slip resistent material such as a textured rubber or the like. Forwardly of the foot areas 45 there are provided upwardly inclined portions 46 on which a rider may position his feet if desired. It should be noted that the foot areas 45 are tapered slightly upwardly toward an area contiguous to the rear end of the seat 41.

There is then provided a more steeply inclined ramp area 47 that offers an area where a rider may brace his feet if he desires to assume such a riding position. Rearwardly of these areas 47, there is provided a transversely extending rear deck portion 48 which has a length L that is at least equal to and preferably greater than the width W of the foot areas 45 and which is also covered by a slip resistent material.

It will be noted that the underside of the rear portion of the seat 41 tapers abruptly in a forward direction. In a like manner, the rear edge of the pedestal 44 tapers abruptly in a forward direction so as to afford a greater foot area for standing at the rear of the watercraft 11 on the rear deck portion 48.

As may be seen in FIG. 1, this permits the passenger to assume a full standing position to the rear of the driver if the driver slides rearwardly on the seat 41 to a rearwardly position location where the driver places his feet against the ramp portion 47. This deck configuration not only provides good footing for the driver and his passenger but also permits the rider and/or passengers to conveniently shift their position on the watercraft so as to assume the desired position, even though the watercraft 11 is in motion. When standing on the deck 48 it will be noted that the rider's feet actually can extend partially beneath the rear portion of the seat 41 due to the forward taper of the underside of the seat and the rear of the pedestal 44 which clearly appear in FIG. 1.

A rider may easily enter the watercraft 11 from the rear since the deck area 48 is opened at the rear and is not defined by an upstanding transom, as with more

conventional types of watercraft. A pair of hand grips 49 are provided on the rear portion of the pedestal 44 and on opposite sides thereof to permit the passengers to easily grip the handles 49 and enter the watercraft from a body of water in which the watercraft is operating.

In addition to being able to sit on the watercraft 11 and specifically its seat 41 like a motorcycle, both the driver and passenger may lean the watercraft like a motorcycle to facilitate turning or the like. To this end, the hull portion 12 is formed in such a way as to offer good buoyancy but never the less permit some leaning without capsizing.

As has been previously noted, the gunnels formed by the interlocking flanges 14 and 15 are disposed at a substantial outboard width and will contact the water to prevent capsizing. However, there are a pair of tapered downwardly converging side sections 51 that are formed adjacent the flanges 14 and which have chines 52 formed at their midsection so as to offer some resistance upon extreme leaning. The side sections 51 then merge into a lower section 53 which is generally plainer but which is comprised of a flat center part 54 and a pair of curved side parts 55 which merge into the lower portion of the sides 51. This point of merger also forms chines 56 that lend to the stability of the watercraft and which maintain directional control while still permitting the leaning operation as aforenoted.

The proportioning of the hull, as aforenoted, is particularly important in permitting leaning of the watercraft 11 like a motorcycle while, at the same time, avoiding capsizing of the watercraft. Typical dimensions are shown for a preferred embodiment of the watercraft in relation to FIG. 5 by the following chart:

W_1: W_2=880: 540
H_1: H_2=380: 300
H_2: W_1=300: 880
(H_1+H_2): W_1=680: 880
H_4: H_3=230: 450
W_1: $W\Delta_3$=880: 410

The dimensions in the above chart are given in centimeters. Of course, these dimensions will change at other cross sections, but the proportions in so far as the width ratios will hold true along the substantial length of the watercraft although the actual dimensions will be different. The same holds true with respect to the heighth relationships.

It should be noted that the seat 41 is removable and is detachably retained to the pedestal 44 by means of a pair of latches 57. A battery compartment 58 that receives a storage battery 59 is positioned centrally of the pedestal 44 beneath the seat 41. In addition, a fire extinguisher 61 may be carried in a cylindrical recess 62 of the seat 41 and held in place by an elastic strap 63. A glove box 64 is also formed rearwardly of the pedestal 44 in the area between the handles 49.

In addition to the fact that the raised or high elevation of the seat 41 permits the riders to be seated in a semi-standing position, the relatively great heighth of the seat 41 above the main portion of the hull gives rise to a large buoyant area disposed above the deck 45. Even though the gunnels 14 and 15 tend to resist capsizing, in the event the watercraft does become capsized, this high buoyant area provided by the seat 41 and the hollow area beneath it will add to the buoyancy of the watercraft and easily permit a displaced rider to right the watercraft if it does become capsized. In addition this heighth of the buoyant area provided by the seat 41 and the raised pedestal 44 will insure that the watercraft cannot become completely inverted.

It should be readily apparent from the foregoing description that the described watercraft easily accommodates a rider and one or more passengers and in such a way that the rider and/or passengers may lean the watercraft like a motorcycle and ride the craft like a motorcycle without fear of capsizing. In addition, the rider and/or passengers may conveniently move their positions to the desired riding posture while the watercraft is in motion without fear of slipping due to the described foot area. Of course, the foregoing description is that of a preferred embodiment of the invention and various changes and modifications may be made without departing from the spirit and scope of the invention, as defined by the appended claims.

We claim:

1. A watercraft having a unitary hull having a lower portion for submersion in a body of water and an integral upper portion defining a deck area disposed above the water line when floating in the water and extending transversely outwardly beyond the wetted area of the submersed part of said lower hull portion when upright, a seat supported in a fixed position upon a portion of said deck area that is raised a substantial distance above said deck area, a pair of foot areas on opposite sides of and below said seat defined by said deck, said foot areas being fixed to said hull and accommodating the feet of a rider seated on said seat in straddle fashion with the rider's knees being at least at a level below said seat and in a generally standing posture, and a control means for said watercraft forwardly of said seat and accessible by a rider seated on said seat, said hull lower portion being configured to facilitate leaning of the entire hull of said watercraft like a motorcycle when turning.

2. A watercraft having a hull as set forth in claim 1 wherein the control means includes a handlebar assembly for steering the watercraft and wherein said handlebar assembly is positioned at substantially the same height as the seat.

3. A watercraft having a hull as set forth in claim 1 wherein the seat defines an elongated seating surface inclined substantially upwardly toward the rear of the watercraft so that a rider on said seat may move to a more erect position as the rider slides rearwardly on said seat.

4. A watercraft having a hull as set forth in claim 3 wherein the seating surface is sufficiently long so as to accommodate two riders seated in straddle fashion thereon in a generally standing posture.

5. A watercraft having a hull as set forth in claim 4 further including a rear deck area to the rear of the seat and sized for accommodating a rider standing thereon.

6. A watercraft having a hull as set forth in claim 5 wherein the foot areas-on the side of the seat extend generally in a horizontal direction and are connected to the rear deck area by upwardly inclined sections against which a rider may brace his feet.

7. A watercraft having a hull as set forth in claim 6 further including a pair of grab handles disposed on opposite sides of the seat and wherein the rear deck area is open so that a rider may enter the watercraft from a body of water in which the watercraft is positioned from the rear.

8. A watercraft having a hull as set forth in claim 1 further including an open rear deck area to the rear of the seat and sized for accommodating a rider standing thereon.

9. A watercraft having a hull having a lower portion for submersion in a body of water and an upper portion defining a deck area disposed above the water line when floating in the water, a seat supported upon a portion of said deck area raised a substantial distance there above the accommodating a rider seat thereon in straddle fashion with the rider's knees being at least at a level below said seat and in a generally standing posture, a pair of foot areas on opposite sides of said seat defined by said deck for accommodating the rider's feet, a control means for said watercraft forwardly of said seat and accessible by a rider seated on said seat, said hull lower portion being configured to facilitate leaning of said watercraft like a motorcycle when turning, and a rear deck area to the rear of said seat and sized for accommodating a rider standing thereon, said raised portion of said deck accommodating said seat being formed with a recess beneath the rear of said seat so as to afford an extended area forwardly of said rear deck area and beneath said seat to accommodate a portion of a rider's body entering onto said rear deck area from the body of water in which the watercraft is operating.

10. A watercraft having a hull as set forth in claim 9 wherein the seat is comprised of an upper portion detachable from a lower portion and wherein the upper and lower portions when connected together define a pair of vertically spaced enclosed buoyant areas.

11. A watercraft having a hull as set forth in claim 10 wherein the upper and lower portions define a cavity therein for storage of articles.

12. A watercraft having a hull as set forth in claim 1 wherein the seat is comprised of an upper portion detachable from a lower portion and wherein the upper and lower portions when connected together define a pair of vertically spaced enclosed buoyant areas.

13. A watercraft having a hull as set forth in claim 12 wherein the upper and lower portions define a cavity therein for storage of articles.

* * * * *

United States Patent [19]

Matsuura

[11] **3,913,929**

[45] **Oct. 21, 1975**

[54] **LOW CENTER OF GRAVITY CYCLE**

[76] Inventor: **Hideji Matsuura**, Suite 505, 17-17 Mita 4-chrome, Minato, Tokyo, Japan

[22] Filed: **Mar. 11, 1974**

[21] Appl. No.: **450,230**

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **280/7.14**; 280/1.11 R; 280/261; 280/269; 280/282; 280/16

[51] **Int. Cl.²** **B62K 23/06**; B62M 1/06

[58] **Field of Search** ..... 280/259, 260, 261, 269, 280/282, 1.11 R, 7.14, 16

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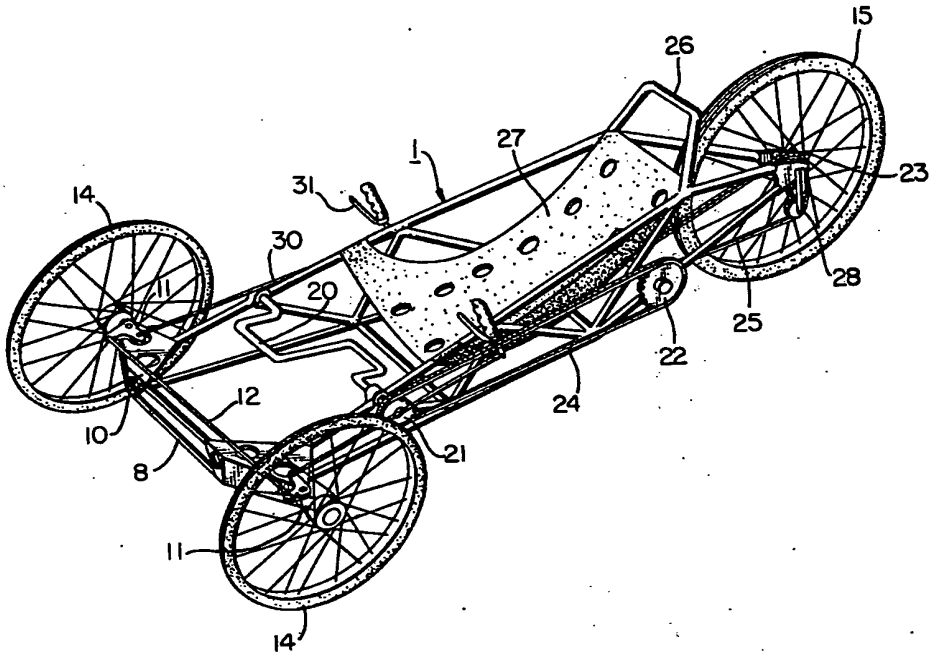
Primary Examiner—Leo Friaglia

Attorney, Agent, or Firm—Armstrong, Nikaido & Wegner

[57] **ABSTRACT**

A low center-of-gravity cycle is provided in which the rider is supported in a substantially lying position on a rider support member mounted on the body of the cycle. Front wheels mounted on the front of the body are used to steer the cycle while a single wheel mounted on the rear of the cycle is used to drive the cycle. The cycle is extremely stable and reduces rider fatigue because of the substantially lying position of the rider which brings about the low center-of-gravity and less air resistance.

7 Claims, 8 Drawing Figures



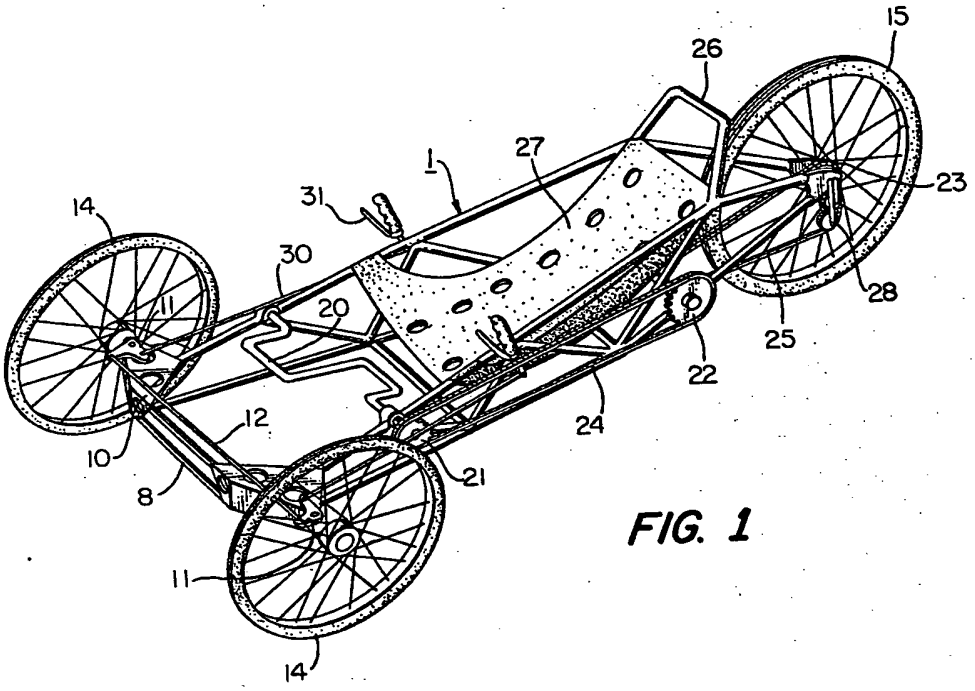

15
26
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FIG. 1

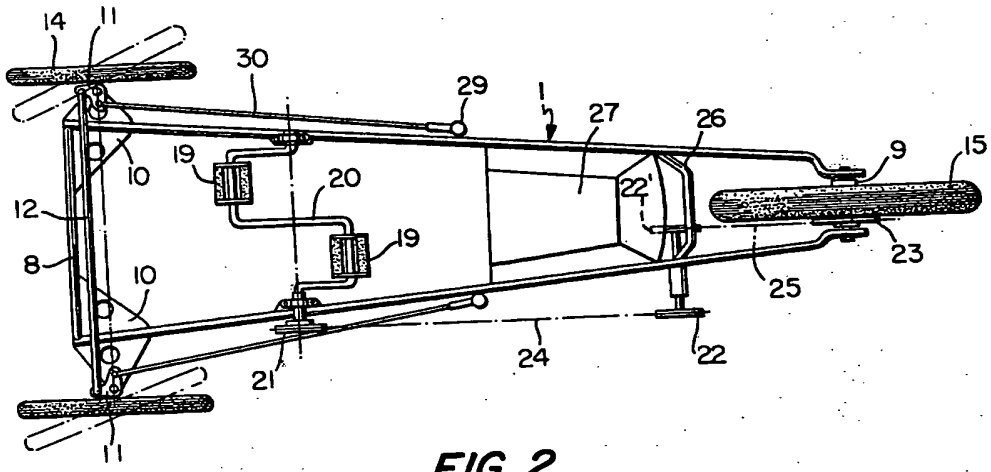
14
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FIG. 2

FIG. 3

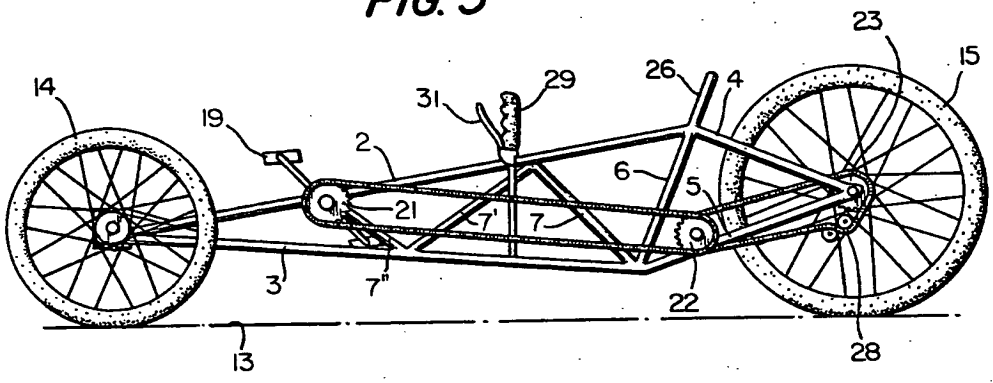
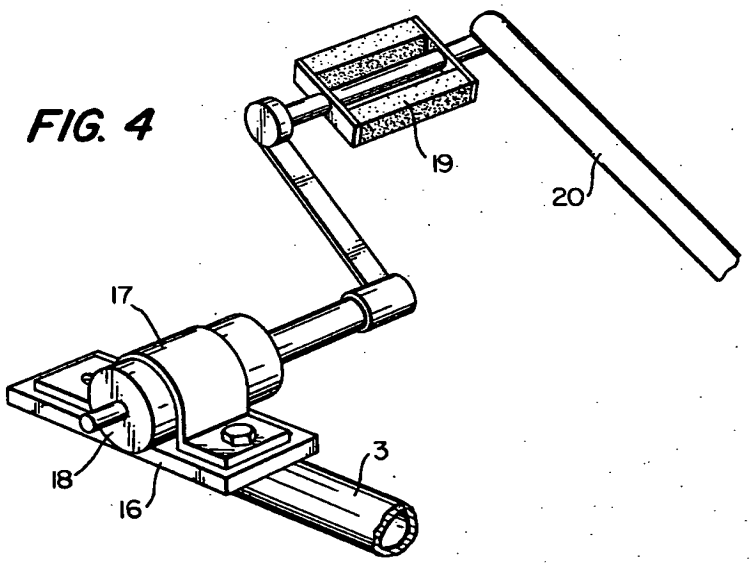


FIG. 4



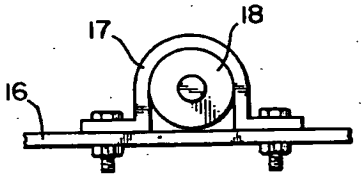
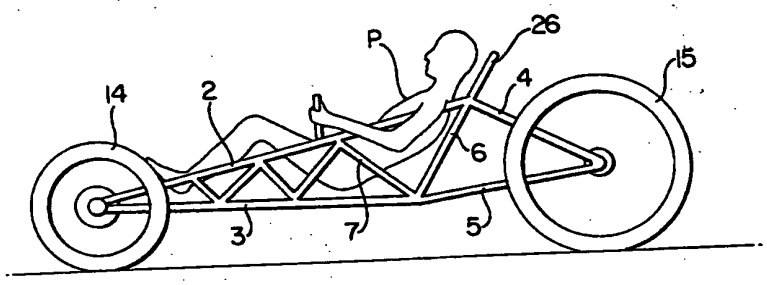


FIG. 5

FIG. 6



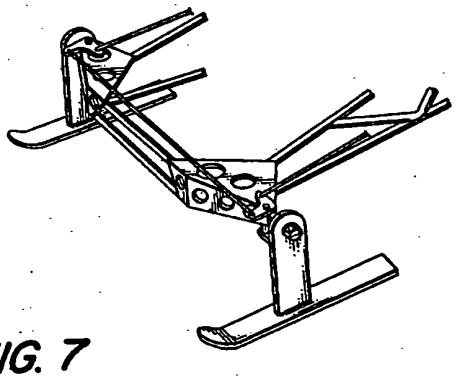
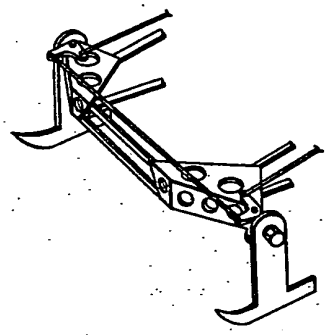


FIG. 7

FIG. 8



LOW CENTER OF GRAVITY CYCLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a low center-of-gravity cycle comprising two front surface touching means such as steering wheels and at least one rear drive wheel for stabilizing a body thereof. The cycle has a rider support means such as a seat whereon a rider can sit at an extremely low position like a racing car driving position in such a manner that he lies substantially on his back. The seat is attached to a body having a side member frame, or panel frame, preferably symmetrical on both sides, comprising metal pipes, rods and plate means made of aluminum, steel and similar materials or molds of synthetic resin.

2. Description of the Prior Art

The conventional tricycles for children are moved by directly pushing the pedal down to drive the front wheel, and similarly the conventional ones for adults are moved by pedaling to drive the two rear wheels. The disadvantage with both types of tricycles is that a rider is positioned high on a saddle or seat such that he must unavoidably bend the upper half of his body or be in an almost upright posture as with typical bicycles. As a consequence, the weight of the upper half of the rider is concentrated on his buttocks resulting in a gradual increase of fatigue due to load concentration during cycling. This causes an intense pain in the rider's legs.

The disadvantage with conventional bicycles is that they are unstable because of two wheels and require training to a certain degree of skill for the rider until he can drive freely.

Furthermore, conventional stable-type cycles are generally used for children or physically handicapped persons and are not operated as an ordinary bicycle.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide various types of low center of gravity cycles which are improved by solving the abovementioned disadvantages and are inexpensive. The cycles are low in the center of gravity and very high in stability both at high and low speeds as well as during braking, thus permitting anyone, young and old, men and women alike, to enjoy healthful cycling for games, matchs and play as well as general transportation without requiring training or skill.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing an embodiment of the present invention.

FIGS. 2 and 3 are respectively plan view and a side view of the embodiment shown in FIG. 1.

FIG. 4 is an enlarged perspective view of one half of a crank shaft 20.

FIG. 5 is a side view of a portion of FIG. 4.

FIG. 6 is a side view illustrating how a rider is seated on the cycle in accordance with the present invention.

FIG. 7 illustrates skis which may be used in place of the front wheels of the cycle.

FIG. 8 illustrates skate blades which may be used in place of the front wheels of the cycle.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIGS. 1, 2 and 3, cycle body 1 is formed of pipe frame, which has a side member frame of pipe made of aluminum, steel or similar metal of very light weight and high hardness. The frame is substantially symmetrical with respect to both sides. As shown in FIG. 3, the side member frame is constructed by combining into a single unit by welding or some other means, a front upper member 2 and a front lower member 3 located at the front portion of the body 1 with a rear upper member 4 and a rear lower member 5 located at the rear portion of the body 1 along with a center member 6 inclined at an angle to the rear direction of the body 1. In combination with the front upper member 2 with the front lower member 3 are a plurality of diagonal members, 7, 7' and 7''.

The front ends of the above-mentioned symmetrical side member frames, that is, the front ends of preferably separated right and left front lower members 3 are rigidly connected together by means of a front cross member 8.

A rear wheel shaft 9 is fitted on the rear ends of the side member frames, in the vicinity of the cross point of the right and left rear upper members 4 and rear lower members 5. The rear ends are positioned fairly close to each other as compared to the front ends, as shown in the drawings.

The body 1 may be constructed of aluminum plate, steel plate, or other similar metal plate or by molding of synthetic resin instead of the abovementioned pipe frame.

On each front side end of the body 1 is fitted a guide arm support 10, which supports a vertical shaft (not shown) or a preferably aligned shaft, on which a guide arm 11 is rotatably fixed. The right and left guide arms 11 are connected together by means of a tie rod 12 or similar means. A wheel 14 is coupled by means of a shaft to each guide arm 11. Each wheel 14 has a well-known brake drum fitted with a number of spokes for supporting a rim covered with an air-filled tire for moderating shocks from road surface 13 (see FIG. 3). The abovementioned rear wheel shaft 9 supports a drive wheel 15 on a bearing.

A drive mechanism for driving the drive wheel 15 is devised as described below with reference to FIGS. 4 and 5. Body 1 is secured to a washer plate 16 (with welding or in another way) on which a bearing 18 is fixed by means of screws and nuts through a bearing holder 17. The bearing 18 rotatably supports the respective ends of a crank shaft 20 fitted with a pair of pedals 19. A primary sprocket 21 is fixed on a rotating shaft, extend- from one end of the crank shaft 20. A primary chain 24 is engaged on the primary sprocket 21 and an idle sprocket 22 is provided in the drive mechanism.

A secondary chain 25 is engaged on the secondary sprocket 22' and a drive sprocket 23 for driving the drive wheel 15 in a similar manner as described above. Gear ratios of the above sprockets are selectable and adjustable.

The rotation of the crank shaft 20 may be transmitted to the drive wheel 15 by using a belt, shaft, rod, or similar means instead of the above sprockets and chains.

In order to take full power of the rider's legs through the crank shaft 20 when his feet alternately push the pair of right and left pedals 19, the body 1 is covered with a seat 27 made of cloth, synthetic resin sheet, metal plate, or similar material, as shown in the drawing, so that he can effectively stay in a low riding pos-

ture as he substantially lies on his back. The seat 27 is so shaped that the reaction of the foot's pedaling force can be received by the back of the seat 27 to which his back is pressed. A roll-over bar 26 is bridged across the rear frame of the body 1 and above the seat 27 to prevent the cycle from rolling over. Should the cycle roll over, the bar 26 will serve to protect the rider's head. A speed change mechanism 28 fitted in the cycle of the present invention is one used for conventional bicycles.

A steering lever handle 29 is fitted on the front upper member 2 of the body 1. An independent handle 29 is provided on each side. The lever handle 29 is linked to a guide arm 11 through a link mechanism of a wire and other means 30 of the steering system. The lever handle 29 can turn to the guide arm 11 to a given direction to permit the pair of shaft mounted wheels 14 to move in parallel. This makes the steering operation easy in any direction. The guide arm 11 may be turned by a conventional steering system comprised of round handle or lever handle instead of the lever handle 29.

The braking system, which is not shown, has a brake lever 31 adjacent to the grip of each lever handle 29 as with conventional bicycles. The brake lever 31, when pressed, pulls a wire or the like to friction brake the rims of the front and rear steering wheels and drive wheel, brake drum, or brake disc.

As clearly seen from the above description of the embodiment, the cycle according to the present invention consists of: first, the body provided with the front cross member to connect the front ends or adjacent portions thereof of the side member frames or panel frames formed symmetrically on both sides. This enables the rider to sit in a very low position as in lying on his back. The cycle has a rear wheel shaft at the rear end, and guide arms which are rotatably supported around the vertical shafts supported by the respective guides arm supports arranged at both sides of the front end of the body. The guide arms are connected together by a tie rod or the like. A pair of shaft-equipped steering wheels are fitted to the respective guide arms, and the drive wheel are supported by the rear wheel shaft with bearings and are driven by a drive mechanism. The drive mechanism includes a crank shaft, having the pair of pedals one on each side, which is fitted on the body. A roll-over bar is positioned across the rear portion of the body and above the seat to insure safety of the rider when the cycle rolls over. A steering link mechanism, comprising a wire, rod or other means, is linked with the guide arms, thereby permitting parallel movement of the pair of steering wheels through the guide arms. Therefore, the cycle according to the present invention is low in its center of gravity and high in stability, and it can be used for sports and other special services as well as general cycling. In addition, it is very light in weight, easy to handle and high in durability.

Furthermore, as shown in FIG. 6, the rider P can remain in a low position in the cycle body such that his weight is broadly distributed throughout the seat. Therefore, the rider is free from any pain at his buttocks due to concentrated load, thus greatly reducing fatigue during cycling and allowing him to rest while remaining in the driving posture.

Furthermore, since the rider lies in a very low position the frontal area is reduced thereby reducing the air resistance by about 25 to 80 percent of the running resistance of conventional riders and bicycles. In addition, since the reaction to the pedaling force of both feet of the rider is received by the back of the seat to which the rider's back is fitted, the force of the whole body can be effectively utilized for pedaling.

Furthermore, the steering mechanism is not required to be high and the strength and difficulty in balancing the weight of the rider's body due to pedaling is eliminated. The steering lever handles are preferably located in the vicinity of his hands in his natural seating posture.

Furthermore, a plurality of screw fitting holes can be additionally bored on the washer plate 16 and bearing holder 17 to adjust the position of the crank shaft according to the height of the rider, if required. This is very effective for the users.

The steering wheels 14' can be replaced by skis 14' for using the cycle in snow or by skate blades 14'' for using the cycle on ice.

The present invention may be embodied in other specific forms without departing from the spirit of or essential characteristics thereof. The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

I claim:

1. A low center of gravity cycle comprising:
   a. body means including first and second side members and coupling members coupling said first and second side members;
   b. rider support means mounted on said body means for supporting the rider of said cycle in a substantially lying position;
   c. surface touching means mounted on the front of said body and touching the surface below said cycle and operatively connected to said body means for supporting said body means above the surface;
   d. wheel means mounted on the rear of said body means wherein said body means is positioned below the plane parallel to the surface through the top of said wheel means such that the center of gravity of said cycle with the rider in said rider support means, lies below said plane;
   e. pedal means positioned to be operated by the rider's feet;
   f. drive linkage means coupling said wheel means to said pedal means wherein the operation of said pedal means by the driver drives said wheel means thereby causing said cycle to move along said surface; and
   g. steering means mounted on said body and positioned to be operated by the rider and coupled to said surface touching means for steering said cycle.

2. The cycle of claim 1 wherein said first and second side members each comprise tubular structural members.

3. The cycle of claim 1 wherein said first and second side members each comprise plate members.

4. The cycle of claim 1 wherein said surface touching means are wheels.

5. The cycle of claim 1 wherein said surface touching means are skis.

6. The cycle of claim 1 wherein said surface touching means are skate blades.

7. The cycle of claim 1 wherein said steering means comprises:

a. manually operated handles means positioned to be held by the rider; and,

b. steering linkage means coupling said handle means to said surface touching means such that movement of said handle means causes a corresponding movement of said surface touching means thereby changing the direction of movement of said cycle.

* * * * *

US005908078A

United States Patent [19]

Belil Creixell

[11] Patent Number: 5,908,078

[45] Date of Patent: Jun. 1, 1999

[54] SUSPENSION/TRANSMISSION MECHANISM FOR MOTORCYCLES AND THE LIKE

[76] Inventor: Jose Luis Belil Creixell, c/homer, 40, E-08023 Barcelona, Spain

[21] Appl. No.: 08/170,332

[22] PCT Filed: Apr. 30, 1993

[86] PCT No.: PCT/ES93/00037

§ 371 Date: May 24, 1994

§ 102(e) Date: May 24, 1994

[87] PCT Pub. No.: WO93/22188

PCT Pub. Date: Nov. 11, 1993

[30] Foreign Application Priority Data

May 4, 1992	[ES]	Spain	9200916
May 29, 1992	[ES]	Spain	9201279
Jun. 3, 1992	[ES]	Spain	9201292
Jun. 26, 1992	[ES]	Spain	9201453
Mar. 30, 1993	[ES]	Spain	9300641

[51] Int. Cl.[6] B62K 11/00; B62M 7/00

[52] U.S. Cl. 180/219; 280/277; 280/285

[58] Field of Search 180/219; 280/284, 280/276, 275, 283, 277, 285

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Primary Examiner—J J Swann

Attorney, Agent, or Firm—Steinberg & Raskin, P.C.

[57] ABSTRACT

The mechanism comprises a swinging arm (1) which pivots at one end on a wheel (2) and at the other end on the frame of the vehicle, and comprises a power pinion (20) and a driven pinion (21) on the shaft of the drive wheel joined together by a chain.

It is characterized in that the swinging arm (1) is arranged parallel to the "antisquat" direction which is defined by the distance between the axes (8,10) of the wheels (2,4) and the center of gravity of the vehicle.

The branches (28,29) of the chain (22) are parallel to the swinging arm (1).

The effects of the drive wheel (2) and the chain (22) on the swinging arm (1), which tend to open and close it, are reduced.

19 Claims, 11 Drawing Sheets

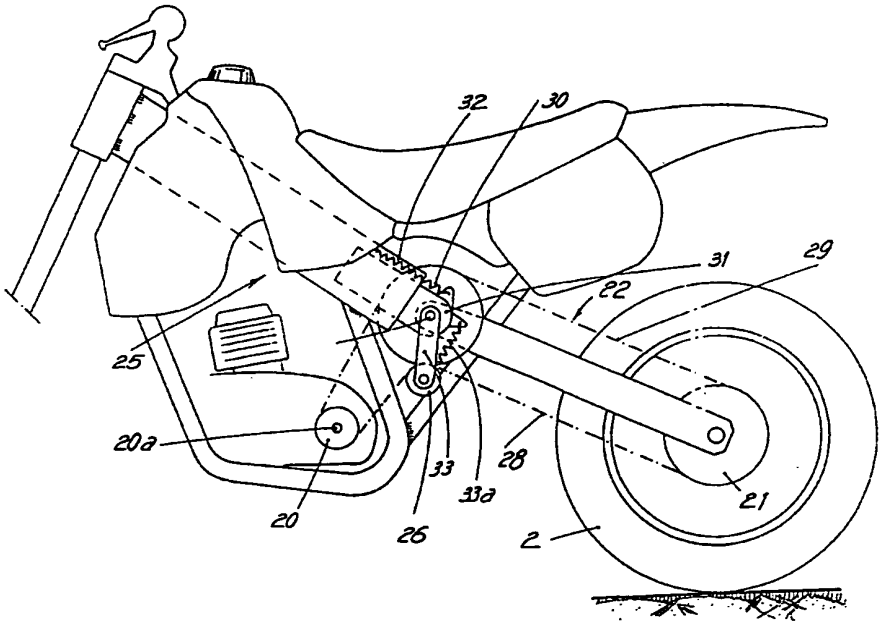

FIG. 1

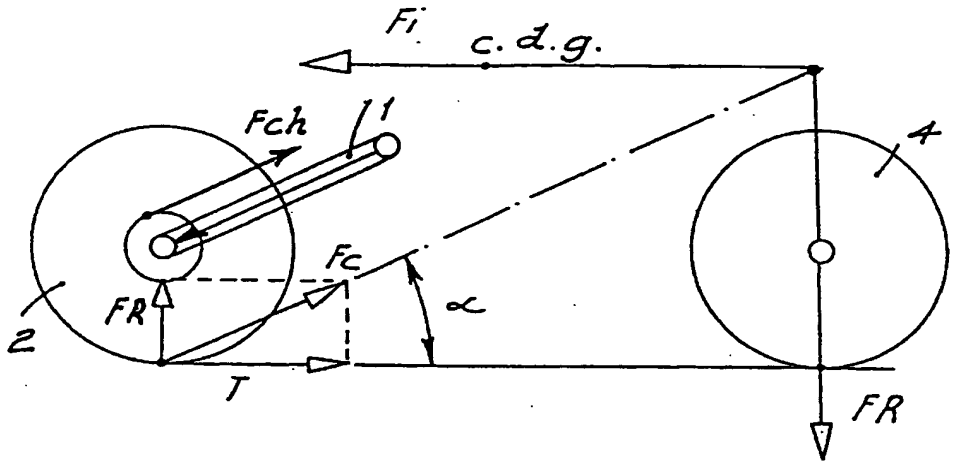
Fi
c.d.g.
Fch
11
4
Fc
FR
α
2
T
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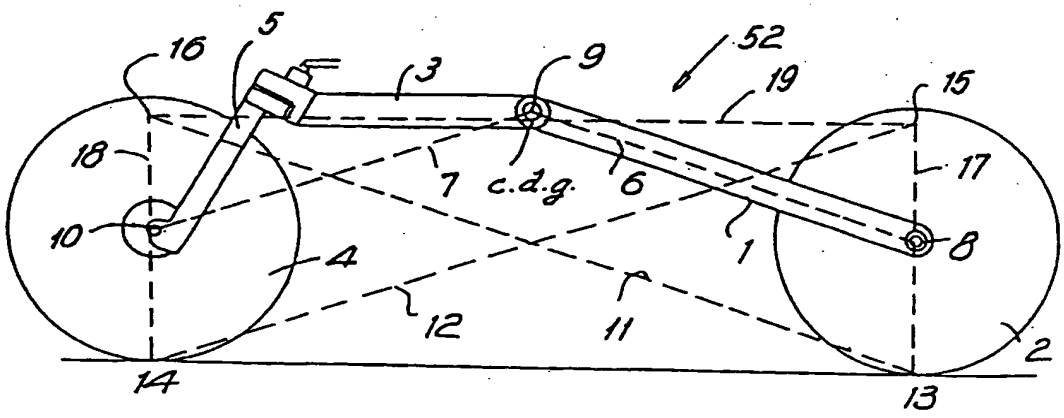
FIG. 2


16
5
3
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52
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14
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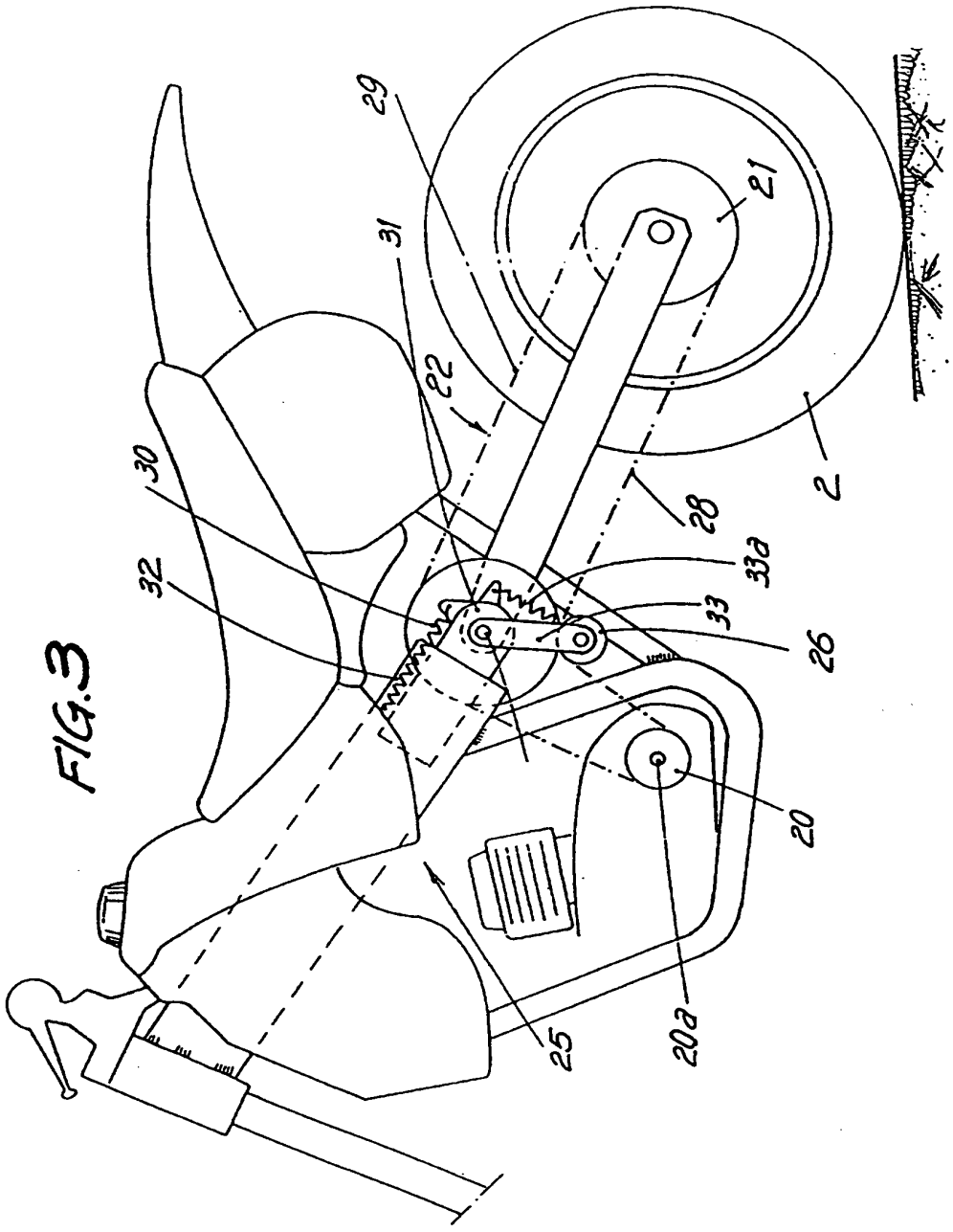


FIG.3

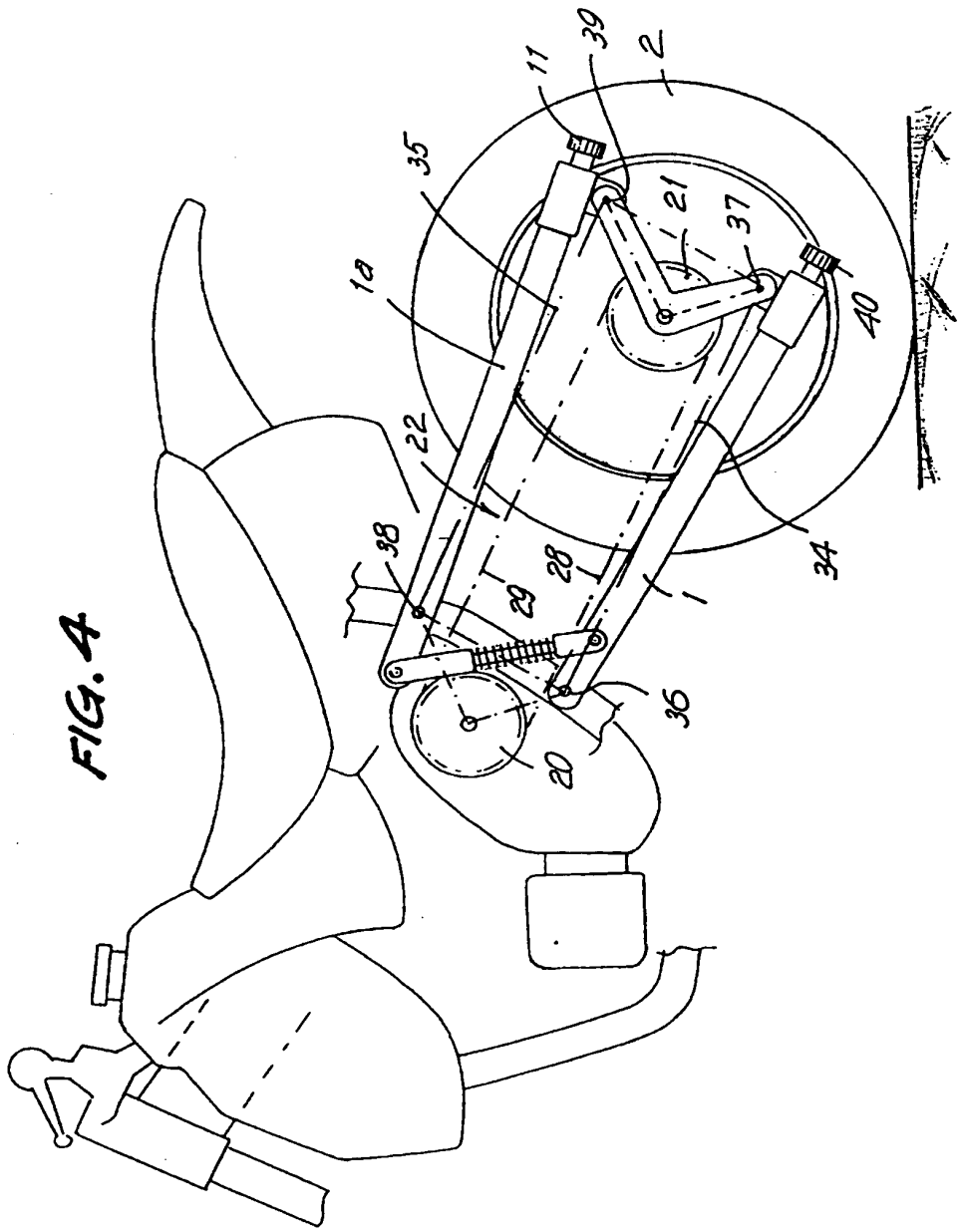


FIG. 4

FIG. 5

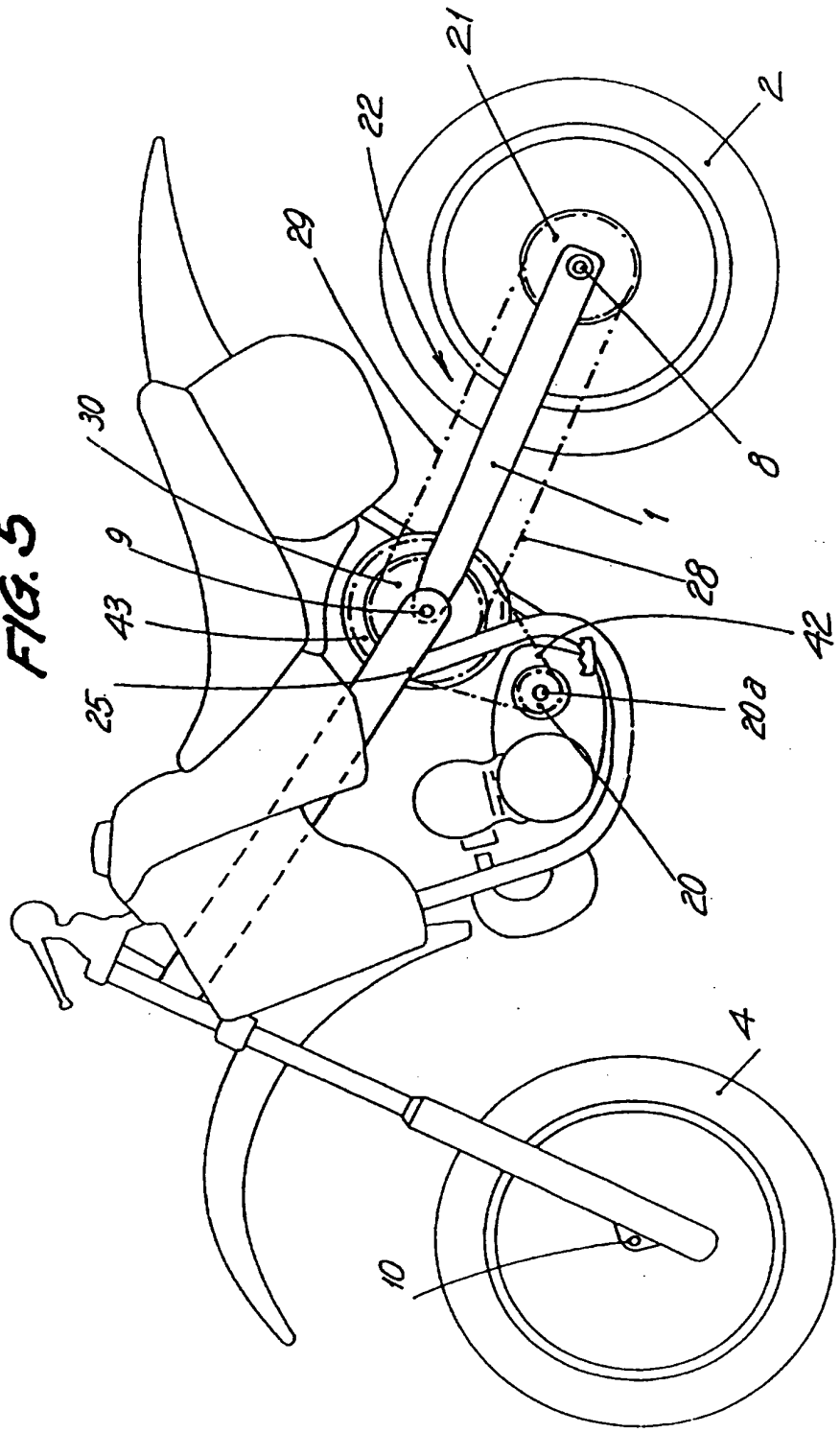


FIG. 6

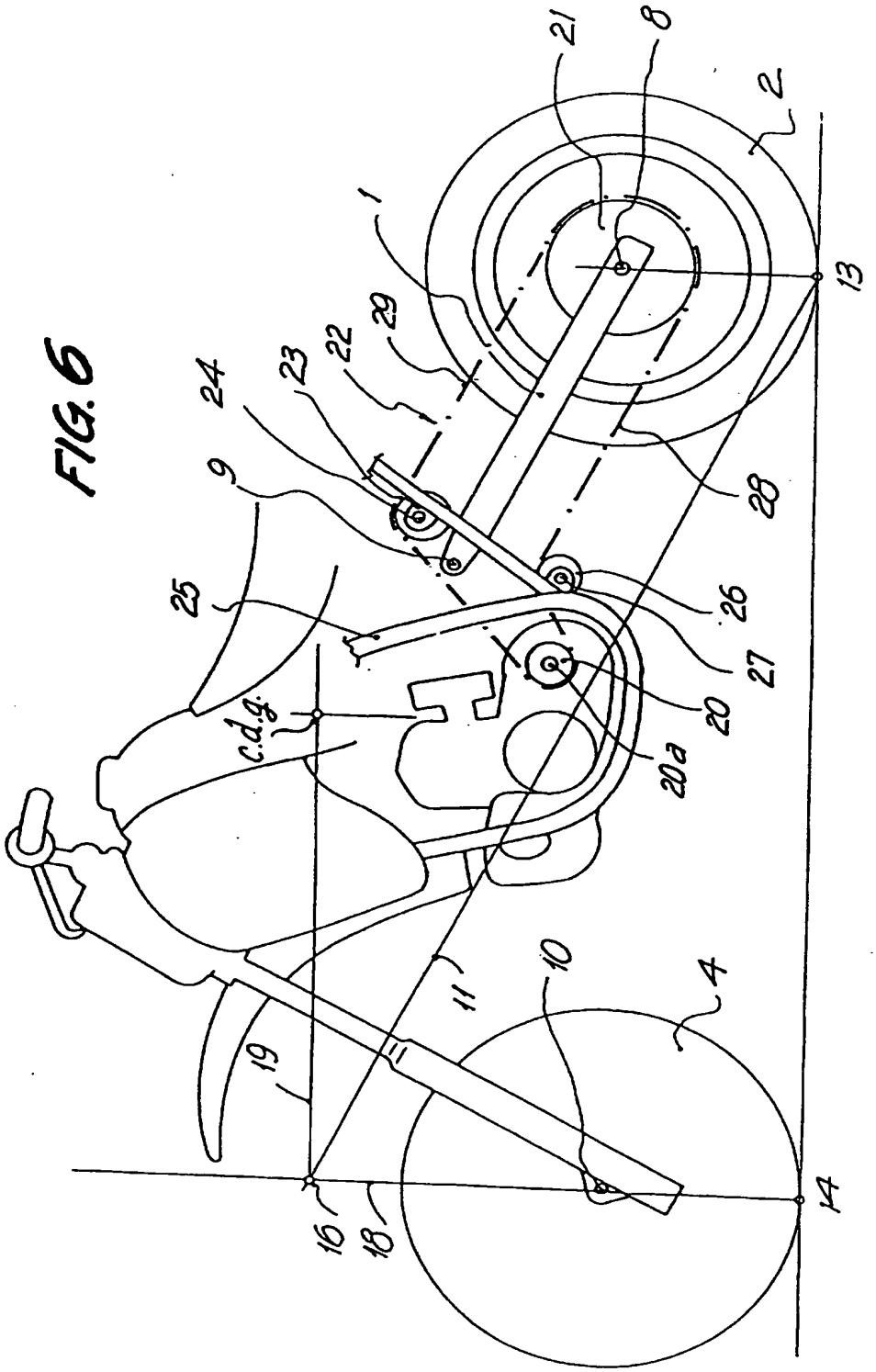


FIG. 7

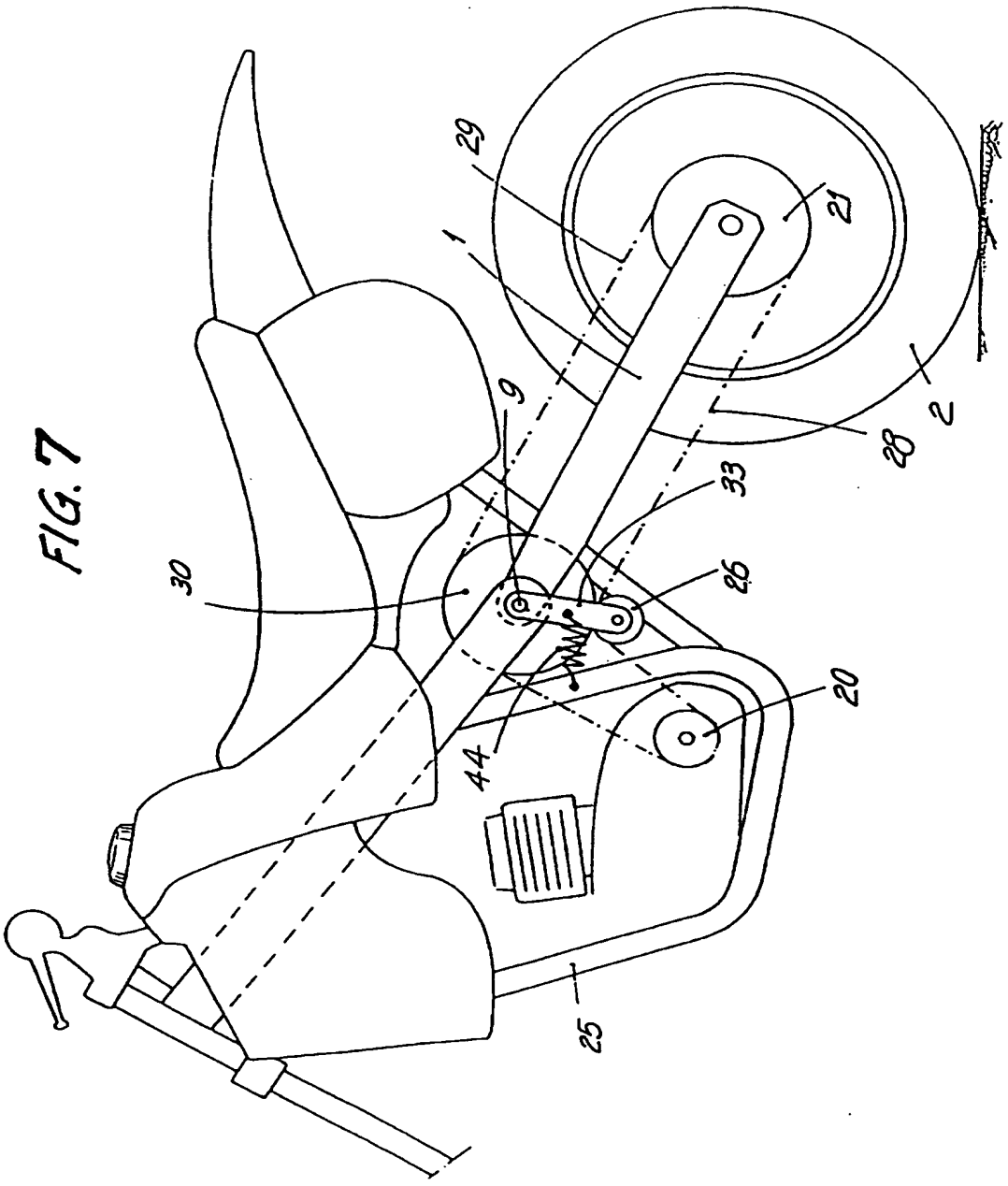


FIG. 8

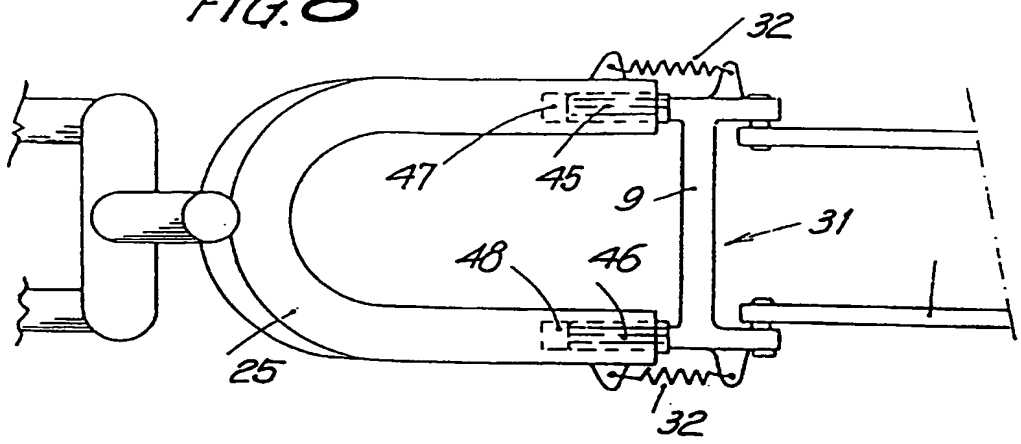


FIG. 9

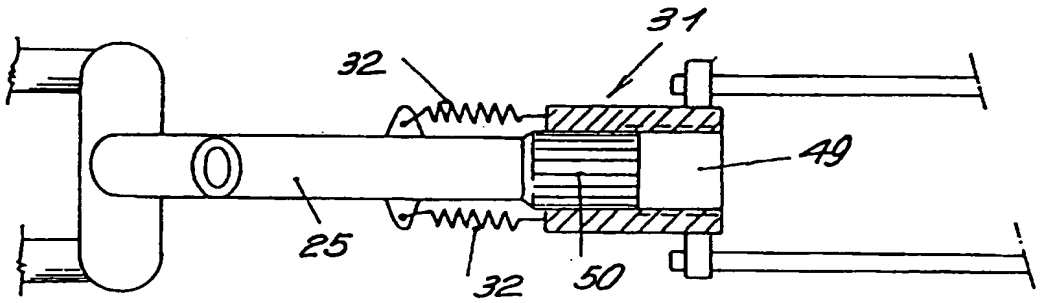


FIG. 10

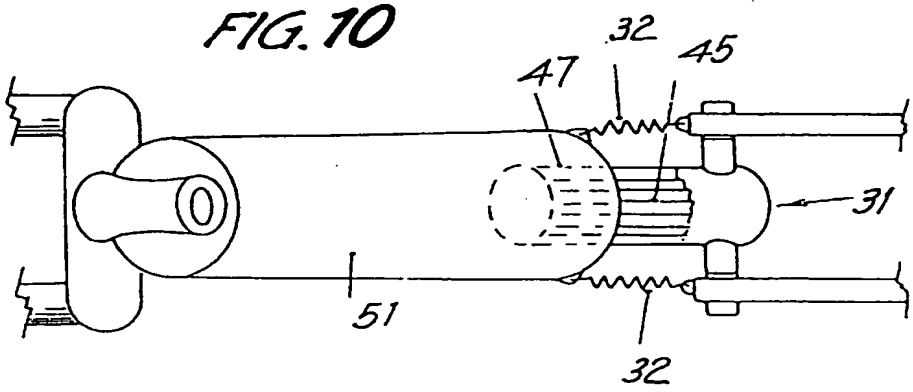


FIG. 11

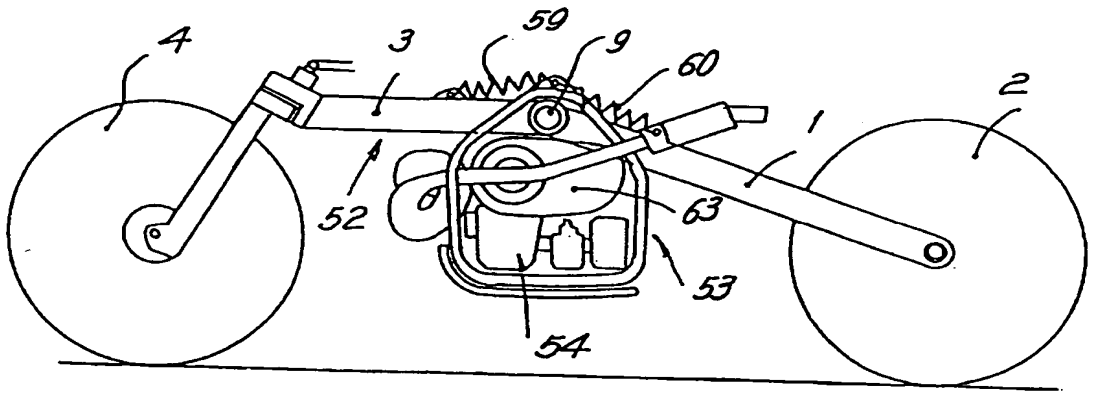
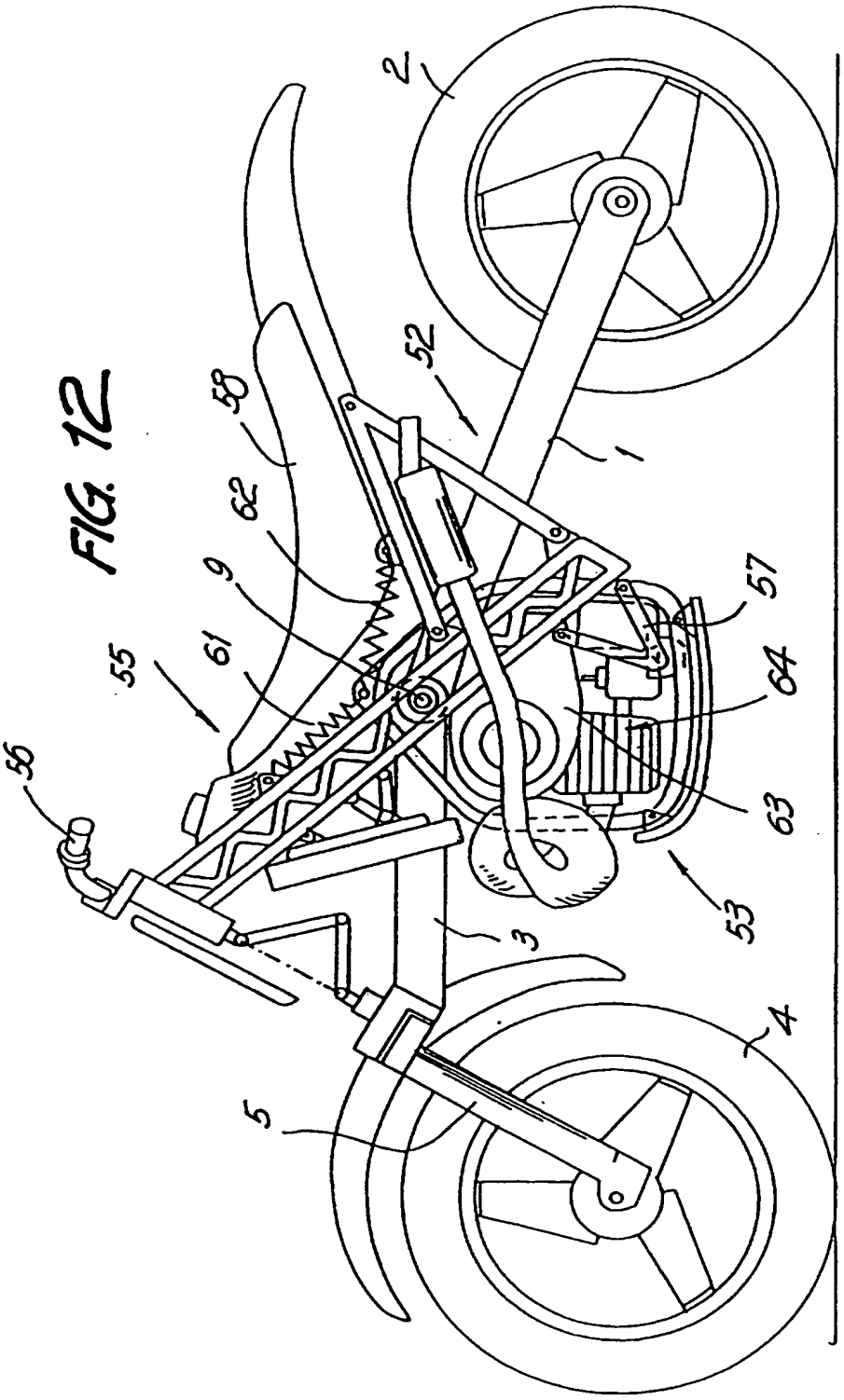


FIG. 12



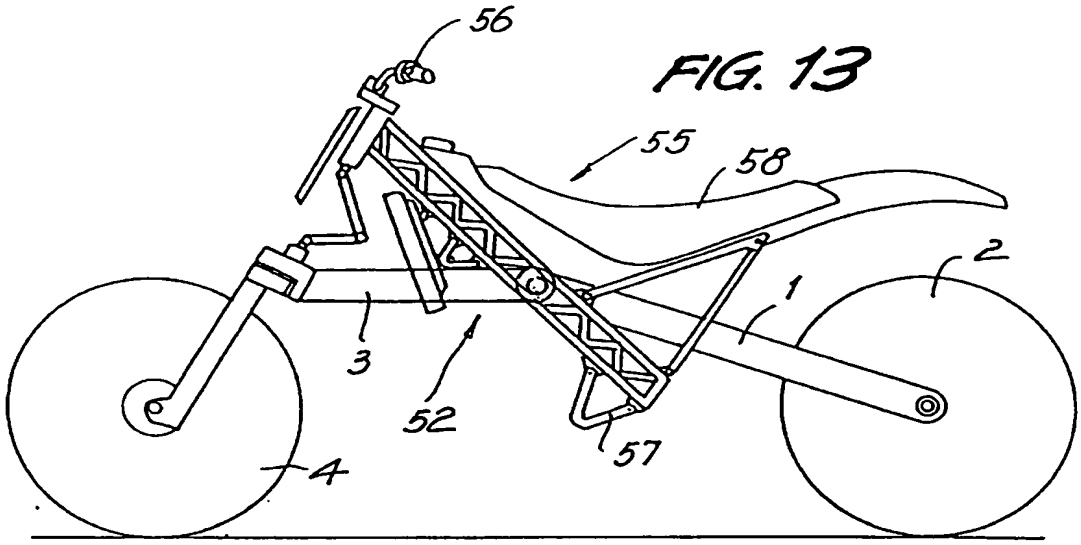


FIG. 13

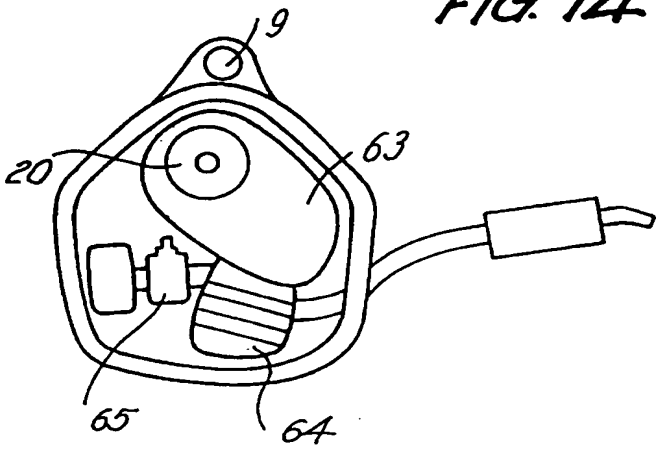
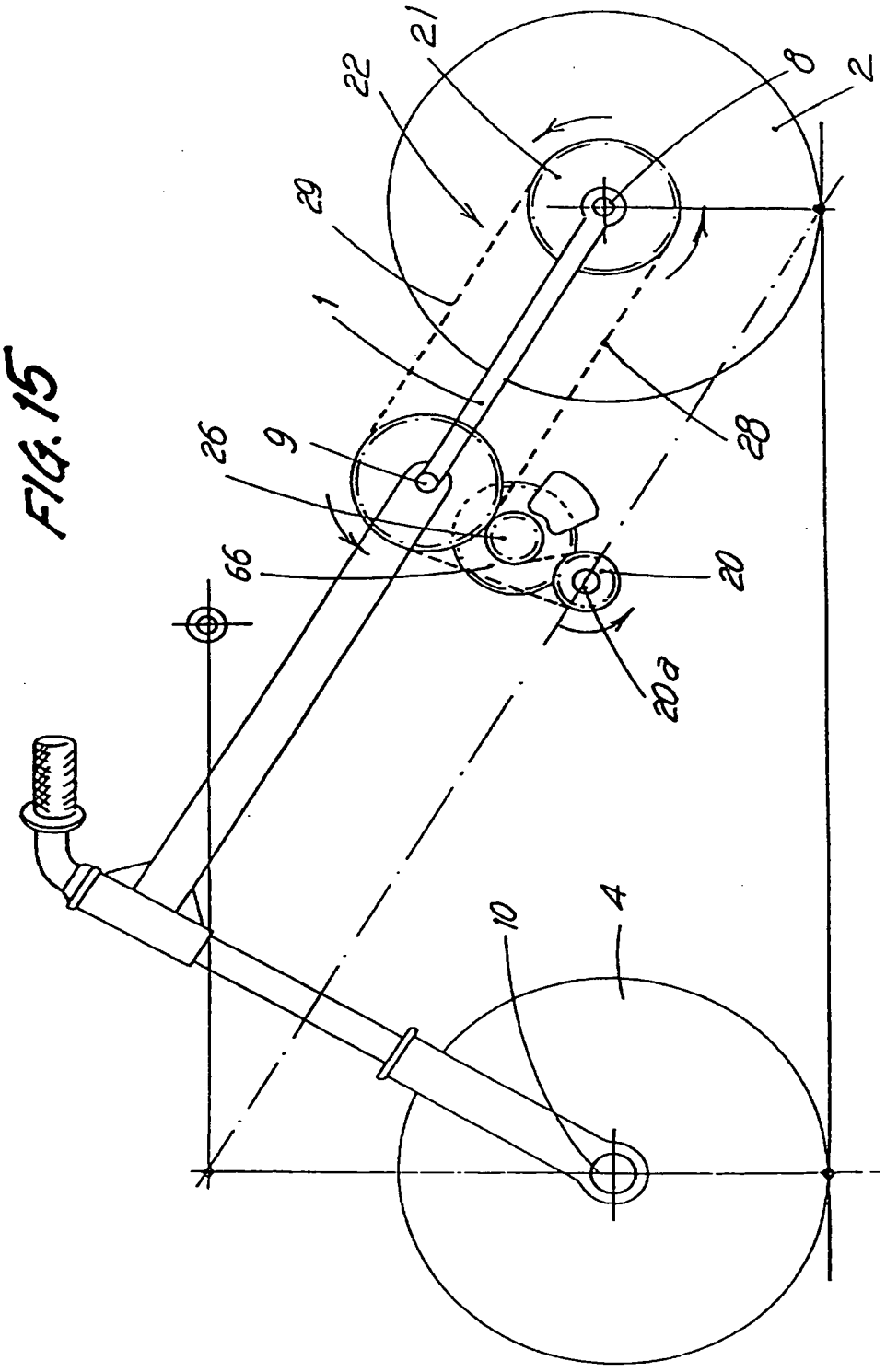


FIG. 14

FIG. 15



SUSPENSION/TRANSMISSION MECHANISM FOR MOTORCYCLES AND THE LIKE

The present invention relates to a suspension/transmission mechanism for motorcycles and the like, comprising at least one swinging arm which pivots at one end on one or both sides of at Least one of the wheels and at the other end on the frame of the vehicle, and comprising a power or drive shaft output pinion and a driven pinion or crown gear on the shaft of the drive wheel joined together by at least one chain or the like.

BACKGROUND OF THE INVENTION

In vehicles which use a suspension/transmission mechanism of the type described, the combined action of the force of the chain and the contact force due to traction can produce reaction forces on the swinging arm which are the cause of considerable instabilities in the vehicle.

The basic design of the chain transmission geometry of conventional motorcycles is suitable for avoiding the lifting or sinking of the rear end during acceleration or deceleration while the traction wheel is fully gripping the ground.

Nevertheless, when the traction wheel loses or recovers its grip with the ground an abrupt change in the equilibrium of forces is produced giving rise to considerable reaction forces on the swinging arm which cause instabilities in the motorcycle such as the phenomena known as "pitching" and "high sider".

Independently of the type of motorcycle suspension/transmission system, the resultant force on the drive wheel at the point of contact with the ground, due to acceleration and in the absence of slipping (the forces due to weight being eliminated), is in a direction known as "antisquat" which is defined by the wheelbase of the motorcycle and the height of the center of gravity.

The effect of any force applied to a wheel which can rotate freely is transferred to the support (in this case the swinging arm) via the pivot while the wheel accelerates.

If the traction wheel suddenly loses its grip with the ground, the contact force disappears and the wheel accelerates. Then only the force of the chain is transferred to the swinging arm via the wheel pivot.

This gives rise to a considerable opening moment of the swinging arm relative to the frame, an effect which is converted into a lifting of the rear end of the vehicle if it is in the vertical position, or an escape of the wheel if the motorcycle is in an inclined position.

If, after hard acceleration, the drive wheel completely and suddenly recovers its grip with the ground, without the force of the chain acting, the contact force reappears due to the rapid deceleration of the wheel.

Then only the contact force is transferred to the swinging arm via the wheel pivot. This force gives rise to a considerable closing moment of the swinging arm relative to the frame which is converted into a dropping of the rear end of the vehicle.

Assuming that the force of the chain is approximately constant while the vehicle accelerates, after the first wheel slip a complex phenomenon of self-sustaining oscillations of the system of forces appears, leading to an oscillation of the contact force intensity relative to its initial value.

This oscillation provokes an opening and closing phenomenon of the swinging arm which gives rise to the continuous instability of the vehicle while accelerating at the limit of its grip.

In fact, as the wheel begins to slip (increasing its angular velocity to a value above that corresponding to the velocity of the vehicle) the couple of the force of the chain becomes greater than that of the contact force of the wheel. Due to the first of the phenomena described above, this produces a tendency for the swinging arm to open which causes an increase in the contact force.

The increase in the contact force causes the drive wheel to decelerate (returning to the wheel velocity which corresponds to the velocity of the vehicle), giving rise to a couple of the contact force on the swinging arm which is greater than that of the force of the chain. Due to the second of the phenomena described above, this produces a tendency for the swinging arm to close, which causes the wheel to lose its grip with the ground and can thus cause it to slip again.

This phenomenon is known as "pitching" and occurs particularly in vehicles with a low weight-to-power ratio. Once it has started in the rear portion of the vehicle it is transmitted to the front suspension and can easily cause the vehicle to become totally unstable.

The instability stops when the rider releases the throttle, which is not convenient during a race.

In the case of a complete and sudden slip at the point at which the wheel is in contact with the ground (due to an oil patch, sand, humidity, painted lines etc.) the first of the two phenomena described gives rise to a violent opening of the swinging arm which tends to throw the rider upwards and forwards with a force comparable to his own weight. This tendency is absorbed to a large extent by the shock absorbers.

If this phenomenon occurs while the motorcycle is in an inclined position on a bend, it can give rise to more complex and more dangerous situations.

In fact, the opening of the swinging arm due to abrupt slipping causes an over-inclination which (often followed by a throttle release) causes the drive wheel to find its grip again. Then the swinging arm closes relative to the frame while the motorcycle moves in the opposite direction and returns to the vertical position. A subsequent reaction force throws the rider upwards.

This phenomenon is known as "high sider" and can cause very dangerous falls.

These phenomena are due on one hand to the arrangement of the swinging arm relative to the frame where the forces which act on the drive wheel are transmitted to the swinging arm, and on the other hand to the direction of the chain which also acts on the swinging arm.

In order to minimize the effects of the drive wheel and the chain on the swinging arm various solutions have been sought based either on controlling the accelerations and decelerations, such that they are effected gradually, or in damping the movements of the swinging arm.

Nevertheless, none of the solutions adopted proposes a new arrangement of the swinging arm relative to the frame, i.e. a design which enables the effects of the drive wheel movements on the swinging arm to be substantially reduced, nor a chain arrangement which minimizes its effects.

DESCRIPTION OF THE INVENTION

The drawbacks described are solved by means of the mechanism of the invention.

The suspension/transmission mechanism for motor-cycles and the like which forms the object of the present invention is characterized in that for at least one of the wheels the virtual line which joins the two pivot points of the swinging

arm is substantially parallel to a line which goes from the point of tangency of that wheel with the ground to a higher point defined by the intersection of a line which runs perpendicular to the ground from the point of tangency with the ground of the opposite wheel and a line which runs parallel to the ground at the height of the center of gravity (if the vehicle and rider assembly in a position of positive or negative acceleration.

By means of the arrangement of the swinging arm in the "antisquat" direction the effects of the drive wheel on the swinging arm, which tend to close it during a complete and sudden recovery of the traction wheel grip, are reduced.

Thus, the mechanism can be applied to the rear wheel, the front wheel or to both wheels simultaneously, reducing the negative effects described which appear particularly during abrupt acceleration and braking. In particular, the effect of abrupt braking is reduced if the mechanism is applied to the front wheel; similarly, the effect of abrupt acceleration is reduced if applied to the rear wheel.

According to one embodiment, the mechanism of the invention comprises, between the power or drive shaft output pinion and the driven pinion or crown gear of the drive wheel, a complementary transfer pinion and a guide pinion or pulley which is rotationally mounted at the high pivot point of the swinging arm and which has a diameter that is substantially equal to that of the crown gear which forms an integral part of the rear wheel, thereby maintaining the two input and output branches of the transmission chain, belt or the like, which act on the driven pinion of the rear wheel, substantially parallel to each other and to the swinging arm.

In this way the reaction forces of the chain on the swinging arm, which tend to open it during complete and sudden slipping of the drive wheel, are reduced.

The branches of the chain can be arranged parallel to each other with various types of transmission.

According to another embodiment, the mechanism of the invention comprises, between the pivot axis where the swinging arm joins the frame of the vehicle and the axis of the power or drive output pinion, a first transmission chain, belt or the like which engages the pinion with a first crown gear or pulley which is coaxial with the axis of the swinging arm, and a second chain or belt which transmits the power from the axis of the swinging arm to the axis of the drive wheel via two more crown gears or pulleys, preferably of the same diameter and mounted on the corresponding axes.

In this embodiment the transfer pinions are eliminated, thereby reducing the changes in the tension of the chain.

According to another embodiment, the mechanism of the invention comprises, between the power pinion and the driven pinion or crown gear of the drive wheel, a guide pinion or pulley which is rotationally mounted at a point on the frame of the vehicle above the pivot axis of the swinging arm on the frame, and a complementary transfer pinion arranged on the transmission itself between the drive wheel and the power pinion, this second transfer pinion being rotationally mounted at a point on the frame of the vehicle below the pivot axis of the swinging arm on the frame, such that between them they keep the two input and output branches of the transmission chain, belt or the like, which act on the driven pinion or crown gear of the rear wheel, substantially parallel to each other and to the swinging arm, the branches being substantially parallel to the diagonal which goes from the point of tangency of the drive wheel with the ground to a higher point defined by the intersection of the virtual axis which runs perpendicular to the ground through the axis of the front wheel and the virtual axis which runs parallel to the ground through the center of gravity of the vehicle and rider assembly in a position of maximum acceleration.

In this embodiment a reduced friction with a single chain is achieved.

Another characteristic of the invention is that the pivot point of at least one of the swinging arms on the frame is situated close to the center of gravity of the vehicle and rider assembly in a position of positive or negative acceleration, at a distance from the center of gravity which is less than the maximum dimension of the crankcase.

In this way the moments which act on the axis of the swinging arm or arms, as the axis moves above or below its optimum working position, are neutralized as much as possible during both maximum acceleration and maximum braking.

Another characteristic of the invention is that it comprises an intermediate piece arranged between the swinging arm and the frame of the motorcycle, the intermediate piece pivoting about the high pivot point of the swinging arm and sliding relative to the frame of the motorcycle in the "antisquat" direction, elastic means being provided between the frame and the intermediate piece.

Since the swinging arm is joined to the frame by means of an intermediate piece, and since elastic means are provided between these two parts, the effect of the jolts produced by the abrupt accelerations and decelerations of the rear wheel is damped. In this way the riding conditions of the motorcycle are improved.

According to another embodiment, the transfer pinion is mounted on a support which pivots about said high pivot point of the swinging arm.

In this way, as the swinging arm moves the transfer pinion can always be arranged in the optimum engagement position, i.e. with its axis always at the same distance from the axis of the guide pinion or pulley.

Advantageously, the suspension/transmission system of the invention comprises elastic means provided between the frame and the support of the transfer pinion.

Said elastic means, for example a spring, compensate the tension of the chain and keep the transfer pinion support in an appreciably stable position.

According to one embodiment the intermediate piece comprises at least one axis which slides within a corresponding housing provided in the frame of the motorcycle, for example a pair of grooved axes which can slide within complementary grooved housings.

According to another embodiment, the intermediate piece comprises at least one housing inside which slides the corresponding axis that forms an integral part of the frame. It can consist, for example, of a grooved housing along which slides the grooved end of the frame.

Advantageously, the suspension/transmission system comprises elastic means arranged between the intermediate piece and the transfer pinion support.

According to another embodiment, the intermediate piece is coupled to the fuel tank of the vehicle. This simplifies the structure of the motorcycle.

Also advantageously, the suspension/transmission mechanism comprises three basic structures which pivot about a common point corresponding to the pivot point of at least one of the swinging arms on the frame, a non suspended structure formed by the elements supported directly by at least one of the wheels, a first suspended structure which

supports the engine, and a second suspended structure which constitutes the rider's grip support, such as handlebars, footpegs or seat, and, in one case, support elements for the other wheel.

In this way the effects of abrupt acceleration and deceleration on the rider are minimized.

The suspension/transmission mechanism also comprises elastic means arranged between the different structures described and, in one case, between the two swinging arms of both wheels. Thus, the oscillations of the wheel or wheels are transmitted first to the first suspended structure which supports the engine, reducing the effect upon the second suspended structure where the rider is placed. In the case of swinging arms on both of the wheels the oscillation can be transmitted from one swinging arm to the other.

According to a preferred embodiment, the engine is mounted in such a way that the crankcase is arranged above the cylinder.

This arrangement of the cylinder relative to the crankcase leaves more free space in the lower part of the motorcycle, enabling it to be inclined further when going around a bend and simultaneously lowering the center of gravity.

The cylinder can be arranged in front of the carburetor, relative to the direction of travel of the vehicle, but it may also be arranged behind to make it easier to connect the exhaust and intake pipes.

Also advantageously, the engine is mounted in such a way that the power pinion is arranged close to the pivot point of at least one of the swinging arms on the frame at a distance which is less than the maximum dimension of the crankcase.

In this way the power pinion is brought as close as possible to the pivot axis of the swinging arms, increasing the transmission performance and even making possible the direct transmission from the power pinion to the crown gear (whose diameter is substantially the same) of the drive wheel axis.

According to another embodiment, the brake disc is mounted directly onto the axis of the transfer pinion situated between the power or drive output pinion and the crown gear which forms an integral part of the drive wheel.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the characteristics of the present invention be better understood, the accompanying drawings show by way of a non-limiting example one practical embodiment thereof.

In the drawings,

FIG. **1** shows schematically the forces which act in the mechanism of the invention;

FIG. **2** shows in side elevation a non suspended structure of the motorcycle of the invention shown in FIG. **12**, where the arrangement of the swinging arms can be seen;

FIG. **3** is a side elevation view of a motorcycle provided with an intermediated piece between the swinging arm and the frame;

FIGS. **4** to **7** show in side elevation various embodiments of the invention with different types of swinging arm and transmission chain;

FIG. **8** is a plan view of the central part of a motorcycle showing an alternative embodiment of the intermediate piece where, for greater clarity, the transmission is not shown;

FIG. **9** is a plan view of the central part of a motorcycle showing another alternative embodiment of the intermediate piece where, for greater clarity, the transmission is not shown;

FIG. **10** is a plan view of the central part of a motorcycle showing another alternative embodiment of the intermediate piece where, for greater clarity, the transmission is not shown;

FIG. **11** shows a first suspended structure which supports the engine together with the non suspended structure shown in FIG. **2**;

FIG. **12** is a side elevation view provided with the structures shown in FIGS. **2**, **11** and **13**;

FIG. **13** shows a second suspended structure which constitutes the rider's grip support together with the non suspended structure shown in FIG. **2**;

FIG. **14** shows in elevation an embodiment of the engine where the cylinder is arranged behind the carburettor to make it easier to connect the exhaust pipe; and

FIG. **15** is a side elevation view of an embodiment of the motorcycle with a particular brake disk arrangement.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As can be seen in FIG. **2** for greater clarity, the suspension mechanism for motorcycles and the like which forms the object of the present invention comprises a swinging arm **1** which pivots at one end about the rear wheel **2** and a swinging arm **3** which pivots about the front wheel **4** via the steering fork **5**.

For both the front wheel **4** and the rear wheel **2** the virtual line **6,7** which joins the two pivot points **8,9**;**9,10** of the swinging arm is parallel to a line **11,12** which goes from the point of tangency **13,14** of the wheel **2,4** with the ground to a high point **15,16** defined by the intersection of a line **17,18** which runs perpendicular to the ground through the point of tangency **13,14** with the ground of the opposite wheel and a line **19** which runs parallel to the ground at the height of the center of gravity (c.o.g.) of the vehicle and rider assembly in a position of positive or negative acceleration.

FIG. **6** shows a motorcycle whose swinging arm **1** fulfils the above conditions and comprises a power pinion **20** (or engine drive shaft **20***a* output pinion), and a driven pinion or crown gear **21** on the axis of the drive wheel, joined by a chain **22**.

It also comprises, between the power pinion **20** and the driven pinion or crown gear **21**, a guide pinion or pulley **23** which is rotationally mounted at a point **24** on the frame **25** of the vehicle above the pivot axis **9** of the swinging arm **1** on the frame, and a complementary transfer pinion **26** arranged in the transmission itself, between the drive wheel **2** and the power pinion **20**.

This second transfer pinion **26** is rotationally mounted at a point **27** on the frame below the pivot axis **9** of the swinging arm such that between them they keep the two input **28** and output **29** branches of the chain **22** substantially parallel to each other and to the swinging arm.

As can be seen the branches **28,29** are substantially parallel to the line **11** which goes from the point of tangency **13** of the drive wheel with the ground to high point **16** defined by the intersection of the virtual axis **18** which runs perpendicular to the ground through the axis **10** of the front wheel **4** and the virtual axis **19** which runs parallel to the ground through the center of gravity (c.o.g.) of the vehicle and rider assembly in a position of maximum acceleration.

The forces which act in the mechanism of the invention are represented in FIG. **1**. The figure shows a rear drive wheel **2** and a front wheel **4**.

The contact force Fc is the resultant of the force FR due to mass transfer and the traction force T, and acts in the "antisquat" direction defined above.

Since the swinging arm 1 is arranged in the "antisquat" direction, the couple which tends to close the winging arm during a complete and sudden recovery of traction wheel grip is eliminated.

By means of the arrangement of the chain, the force Fch exerted by the chain does not produce a couple tending to open the swinging arm during a complete and sudden slipping of the drive wheel.

The embodiments shown in FIGS. 3, 4, 5 and 7 also fulfil the same conditions of the swinging arm or arms and of the chain, but have further particular characteristics.

The embodiment shown in FIG. 3 comprises, between the power pinion 20 and the driven pinion or crown gear 21, a complementary transfer pinion 26 and a guide pinion or pulley 30 which is rotationally mounted at the high pivot point 9 of the swinging arm and which has a diameter that is substantially equal to that of the crown gear 21 which forms an integral part of the rear wheel 2, thereby maintaining the two input and output branches 28,29 of the chain 22, which act on the driven pinion 21 of the rear wheel 2, substantially parallel to each other and to the swinging arm 1.

This embodiment also comprises an intermediate piece 31 arranged between the swinging arm 1 and the frame 25 of the motorcycle. This intermediate piece 31 pivots about the high pivot point 9 of the swinging arm 1 and slides relative to the frame 25 of the motorcycle in the "antisquat" direction. Elastic means 32 are provided between the frame 25 and the intermediate piece 31. The transfer pinion 26 is mounted on a pivoting support 33 joined to the intermediate piece with elastic means 33*a*.

FIG. 4 shows an embodiment which meets the same conditions of the invention, but which has two swinging arms 1,1*a* of the type described in the Spanish addition certificate 8703028. In this case it is the virtual lines 34,35 joining the pivot points 36,37 and 38,39 which are substantially parallel to the "antisquat" direction and to the branches 28,29 of the chain 22. This embodiment has the additional advantage that it is provided with means 40,41 of regulating the length of the swinging arms 1,1*a* in order to adjust the tension in the chain.

FIG. 5 shows an embodiment which comprises, between the pivot axis 9 of the swinging arm 1 on the frame 25 of the vehicle and the axis 20*a* of the power pinion 20, a first chain 42 which engages said pinion 20 with a first crown gear 43 which is coaxial with the axis 9 of the swinging arm 1, and a second chain 22 which transmits the power from the axis 9 of the swinging arm 1 to the axis 8 of the drive wheel 2 via two more crown gears 21,30 of the same diameter.

The embodiment shown in FIG. 7 has a swinging arm and a chain mechanism which are identical to those of FIG. 3. In this case the transfer pinion 26 is mounted on a support 33 which pivots about the high pivot point 9 of the swinging arm 1 without the intermediate piece 31. The support 33 is joined to the frame 25 with elastic means.

FIG. 8 shows an alternative embodiment of the intermediate piece 31 shown in FIG. 3. The intermediate piece 31 comprises a pair of axes 45,46 which slide within corresponding housings 47,48 provided in the frame 25 of the motorcycle. The elastic means 32 can also be seen in the figure.

In the embodiment shown in FIG. 9 the intermediate piece 31 comprises at least one housing 49 inside which slides a corresponding axis 50 which forms an integral part of the frame 25 of the motorcycle

In the embodiment shown in FIG. 10 the intermediate piece 31 is housed in the fuel tank 51 of the motorcycle and it slides therein.

FIG. 12 shows a motorcycle with the swinging arm arranged in a direction which is appreciably parallel to the "antisquat" direction.

As can be seen in FIG. 2, the center of gravity (c.o.g.) is situated very close to the pivot point 9 of the swinging arms 1,3. The distance between these two points is much less than the maximum dimension of the crankcase 63 (FIG. 12).

As the FIGS. 2, 11, 12 and 13 show, the motorcycle represented in FIG. 12 comprises three basic structures which pivot about a common point 9 corresponding to the pivot point of the swinging arms 1,3 on the frame:

- a non suspended structure 52, represented separately in FIG. 2, formed by the elements which are directly supported by the wheels 2,4,
- a first suspended structure 53, represented in FIG. 11 together with the non suspended structure 52, said suspended structure supporting the engine 54,
- and a second suspended structure 55, represented in FIG. 13 together with the non suspended structure 52, said suspended structure 55 constituting the rider's grip support, such as handlebars 56, footpegs 57 or seat 58.

The suspension mechanism also comprises elastic means 59,60 (FIG. 11) and 61,62 (FIG. 1) provided between the various structures.

Although for simplicity it has not been shown, the two swinging arms 1,3 may be arranged on either side of the motorcycle.

In the preferred embodiment shown in FIG. 12 the crankcase 63 is located above the cylinder 64. This arrangement of the cylinder relative to the crankcase leaves more free space in the lower part of the motorcycle, enabling it to be inclined further when going around a bend and lowering the center of gravity.

According to another embodiment shown in FIG. 14, the cylinder 64 can be arranged behind the carburetor 65, relative to the direction of travel of the vehicle, to make it easier to connect the exhaust and intake pipes.

As said figure shows, the engine is mounted in such a way that the power pinion 20 is arranged close to the pivot point 9 of the winging arms 1,3 at a distance which is less than the maximum dimension of the crankcase 63.

FIG. 15 is a side elevation view of an embodiment of the motorcycle with a particular brake disk arrangement.

FIG. 15 shows an embodiment in which the brake disc 66 is mounted directly onto the axis of the transfer pinion 26 situated between the power or drive output pinion 20 and the crown gear 21 which forms an integral art of the drive wheel 2.

I claim:

1. A suspension/transmission mechanism for motorcycles and other vehicles having at least one wheel and a motor output, comprising

a frame,

at least one elongate swinging arm for coupling said at least one wheel to said frame, said at least one swinging arm being structured and arranged to pivot at a first pivot point at one end on at least one side of said at least one wheel and at a second pivot point at the other end on said frame,

one of a power pinion and an engine drive shaft pinion coupled to the motor output,

one of a driven pinion and a crown gear arranged on a shaft of said at least one wheel,

at least one chain for motively coupling said one of said power pinion and said engine drive shaft pinion to said one of said driven pinion and said crown gear,

said at least one swinging arm being arranged such that a virtual line joining said first and second pivot points is substantially parallel to a line extending from a point of tangency of said at least one wheel with the ground to a high point defined by the intersection of a line which runs perpendicular to the ground through the point of tangency with the ground of a wheel opposite said at least one wheel and a line extending substantially parallel to the ground at the height of the center of gravity of the vehicle and rider assembly in a position of positive and negative acceleration in a horizontal direction,

a complementary transfer pinion arranged between said one of said power pinion and said engine drive shaft pinion and said one of said driven pinion and said crown gear, and

a guide member arranged between said one of said power pinion and said engine drive shaft pinion and said one of said driven pinion and said crown gear and rotationally mounted at said second pivot point, said guide member having a diameter equal to a diameter of said one of said driven pinion and said crown gear, said at least one wheel being a rear wheel of the vehicle, said one of said driven pinion and said crown gear forming an integral part of said rear wheel, said at least one chain comprising a first chain for operatively connecting said one of said driven pinion and said crown gear and said guide member such that portions of said first chain between said one of said driven pinion and said crown gear and said guide member are substantially parallel to each other and to said at least one swinging arm.

2. The mechanism of claim 1, further comprising

one of an additional crown gear and a pulley having a rotational axis coincident with said second pivot point, said guide member having a rotational axis coincident with said second pivot point and rotationally connected to said one of said additional crown gear and said pulley, said at least one chain further comprising a second chain for operatively connecting said one of said power pinion and said engine drive shaft pinion and said one of said additional crown gear and said pulley, said guide member and said one of said driven pinion and said crown gear having substantially the same diameter and substantially the same axis of rotation, said one of said power pinion and said engine drive shaft pinion transferring motive power to said one of said driven pinion and said crown gear on said at least one wheel via said first and second chains.

3. The mechanism of claim 1, wherein said guide member comprises one of a guide pinion and a pulley rotationally mounted at a first mounting point on said frame between said one of said power pinion and said engine drive shaft pinion and said one of said driven pinion and said crown gear of said at least one wheel, said first mounting point being situated above said second pivot point of said at least one swinging arm, and

a second complementary transfer pinion arranged between said at least one wheel and said one of said power pinion and said engine drive shaft pinion, said second transfer pinion being rotationally mounted at a second mounting point on said frame below said second pivot point of said at least one swinging arm, said at least one chain further comprising a second chain for operatively connecting said one of said driven pinion and said crown gear and said one of said power pinion and said engine drive shaft pinion such that a first portion of said second chain between said second transfer pinion and said one of said driven pinion and said crown gear and a second portion of said first chain between said one of said guide pinion and said pulley and said one of said driven pinion and said crown gear are substantially parallel to each other and to said at least one swinging arm, said at least one wheel being a rear wheel of the vehicle and said wheel opposite said at least one wheel being a front wheel of the vehicle, said first and second portions of said second chain being substantially parallel to the line extending from the point of tangency of said rear wheel with the ground to the high point defined by the intersection of the line which runs perpendicular to the ground through the point of tangency with the ground of said front wheel and the line extending substantially parallel to the ground through the center of gravity of the vehicle at the height of the center of gravity of the vehicle and rider assembly in the position of positive acceleration in the horizontal direction.

4. The mechanism of claim 1, wherein said second pivot point of said at least one swinging arm is situated close to the center of gravity of the vehicle and rider assembly in the position of positive and negative acceleration in the horizontal direction at a distance from the center of gravity which is less than a maximum dimension of a crankcase of the vehicle.

5. The mechanism of claim 1, further comprising

an intermediate piece arranged between said at least one swinging arm and said frame for connecting said at least one swinging arm to said frame, said intermediate piece being structured and arranged to pivot about said second pivot point and slide relative to said frame, and

elastic means arranged between said frame and said intermediate piece.

6. The mechanism of claim 1, further comprising a support coupled to said frame and rotatable about said second pivot point, said transfer pinion being mounted on said support.

7. The mechanism of claim 5, wherein said intermediate piece comprises at least one axis which slides within a corresponding housing provided in said frame.

8. The mechanism of claim 5, wherein said intermediate piece comprises at least one housing inside which slides a corresponding axis which forms an integral part of said frame.

9. The mechanism of claim 6, further comprising

an intermediate piece arranged between said at least one swinging arm and said frame for connecting said at least one swinging arm to said frame, said intermediate piece being structured and arranged to pivot about said second pivot point and slide relative to said frame, and

elastic means arranged between said intermediate piece and said support on which said transfer pinion is mounted.

10. The mechanism of claim 5, wherein said intermediate piece is coupled to a fuel tank of the vehicle.

11. The mechanism of claim 6, further comprising elastic means arranged between said frame and said support on which said transfer pinion is mounted.

12. The mechanism of claim 1, further comprising

a first suspended structure which support an engine, and

a second suspended structure which constitutes a rider's grip support, said first and second structure being pivotable about said second pivot point, said at least one swinging arm constituting a third structure pivotable about said second pivot point.

13. The mechanism of claim 12, wherein the engine is mounted in said first suspended structure such that a crankcase of the engine is arranged above a cylinder of the engine.

14. The mechanism of claim 12, wherein the engine is mounted in said first suspended structure such that said one of said power pinion and said engine drive shaft pinion is arranged close to said second pivot point of said at least one of swinging arm at a distance which is less than a maximum dimension of a crankcase of the engine.

15. The mechanism of claim 1, wherein a brake disk of the vehicle is mounted directly onto an axis of said transfer pinion.

16. The mechanism of claim 3, wherein said guide member comprises a guide pinion or a guide pulley.

17. The mechanism of claim 1, wherein said at least one swinging arm is substantially rigid and inelastic.

18. A suspension/transmission mechanism for motorcycles and other vehicles having at least one wheel and a motor output, comprising

a frame,

at least one elongate swinging arm for coupling said at least one wheel to said frame, said at least one swinging arm being structured and arranged to pivot at a first pivot point at one end on at least one side of said at least one wheel and at a second pivot point at the other end on said frame, said at least one swinging arm being arranged such that a virtual line joining said first and second pivot points is substantially parallel to a line extending from a point of tangency of said at least one wheel with the ground to a high point defined by the intersection of a line which runs perpendicular to the ground through the point of tangency with the ground of a wheel opposite said at least one wheel and a line extending substantially parallel to the ground at the height of the center of gravity of the vehicle and rider assembly in a position of positive and negative acceleration,

one of a power pinion and an engine drive shaft pinion coupled to the motor output,

one of a driven pinion and a crown gear arranged on a shaft of said at least one wheel,

at least one chain for motively coupling said one of said power pinion and said engine drive shaft pinion to said one of said driven pinion and said crown gear,

a complementary transfer pinion arranged between said one of said power pinion and said engine drive shaft pinion and said one of said driven pinion and said crown gear,

a guide member arranged between said one of said power pinion and said engine drive shaft pinion and said one of said driven pinion and said crown gear and rotationally mounted at said second pivot point, said guide member having a diameter equal to a diameter of said one of said driven pinion and said crown gear, said at least one wheel being a rear wheel of the vehicle, said one of said driven pinion and said crown gear forming an integral part of said rear wheel, said at least one chain comprising a first chain for operatively connecting said one of said driven pinion and said crown gear and said guide member such that portions of said first chain between said one of said driven pinion and said crown gear and said guide member are substantially parallel to each other and to said at least one swinging arm,

a support coupled to said frame and rotatable about said second pivot point, said transfer pinion being mounted on said support,

an intermediate piece arranged between said at least one swinging arm and said frame for connecting said at least one swinging arm to said frame, said intermediate piece being structured and arranged to pivot about said second pivot point and slide relative to said frame, and

elastic means arranged between said intermediate piece and said support on which said transfer pinion is mounted.

19. A suspension/transmission mechanism for motorcycles and other vehicles having at least one wheel and a motor output, comprising

a frame,

at least one swinging arm for coupling said at least one wheel to said frame, said at least one swinging arm being structured and arranged to pivot at a first pivot point at one end on at least one side of said at least one wheel and at a second pivot point at the other end on said frame, said at least one swinging arm being arranged such that a virtual line joining said first and second pivot points is substantially parallel to a line extending from a point of tangency of said at least one wheel with the ground to a high point defined by the intersection of a line which runs perpendicular to the ground through the point of tangency with the ground of a wheel opposite said at least one wheel and a line extending substantially parallel to the ground at the height of the center of gravity of the vehicle and rider assembly in a position of positive and negative acceleration,

one of a power pinion and an engine drive shaft pinion coupled to the motor output,

one of a driven pinion and a crown gear arranged on a shaft of said at least one wheel,

at least one chain for motively coupling said one of said power pinion and said engine drive shaft pinion to said one of said driven pinion and said crown gear,

an intermediate piece arranged between said at least one swinging arm and said frame for connecting said at least one swinging arm to said frame, said intermediate piece being structured and arranged to pivot about said second pivot point and slide relative to said frame, said intermediate piece being coupled to a fuel tank of the vehicle, and

elastic means arranged between said frame and said intermediate piece.

* * * * *

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Schweizer

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[54] **BICYCLE CAPABLE OF VERTICAL MOTION**

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[21] Appl. No.: **08/956,801**

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[30] **Foreign Application Priority Data**

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Apr. 30, 1997 [DE] Germany ..... 297 07 841 U

[51] **Int. Cl.**[7] **B62M 1/02**

[52] **U.S. Cl.** **280/260**; 446/440

[58] **Field of Search** 280/260; 446/315, 446/440; 182/42

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Assistant Examiner—Michael Cuff
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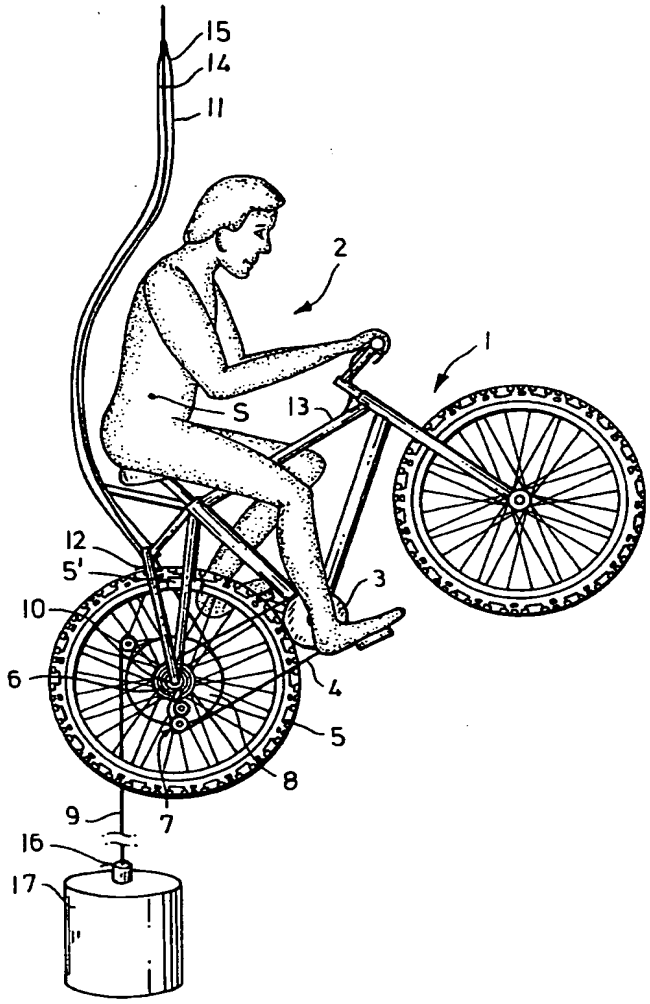
[57] **ABSTRACT**

A vehicle in the form of a bicycle with a crankset drive, which is in active frictioned gripping or positive connection with a strand extending substantially vertically. The bicycle according to the invention is therefore capable of riding along the vertical strand.

17 Claims, 3 Drawing Sheets



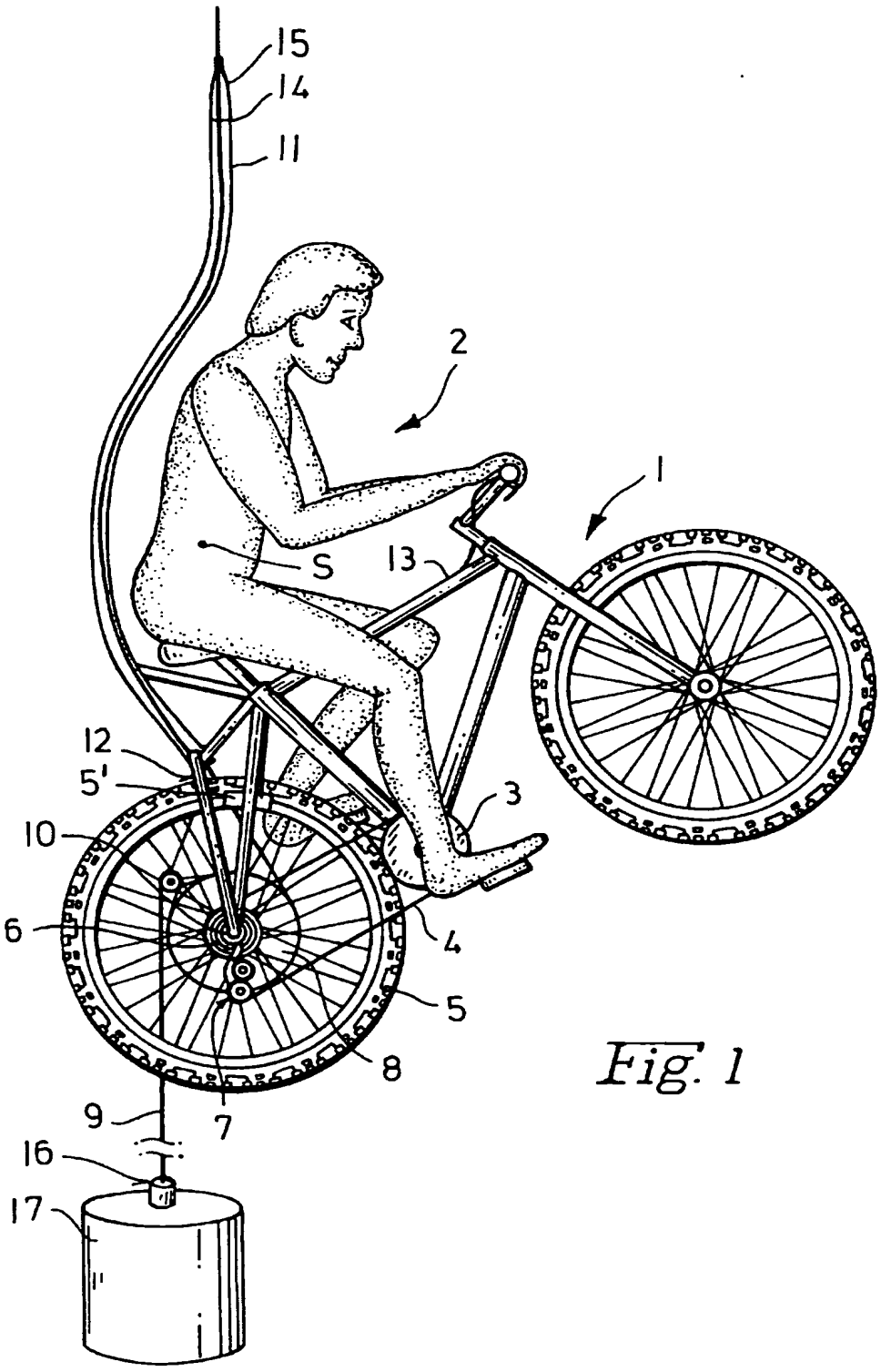


Fig. 1

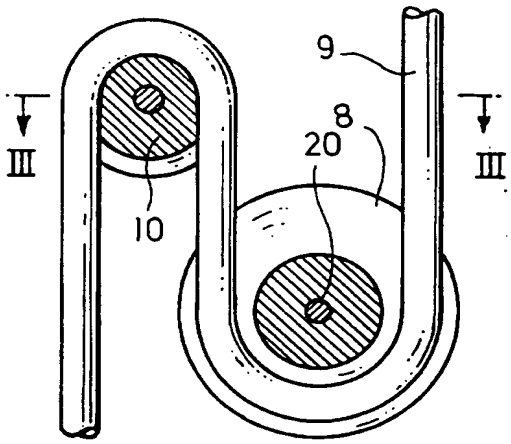


Fig. 2

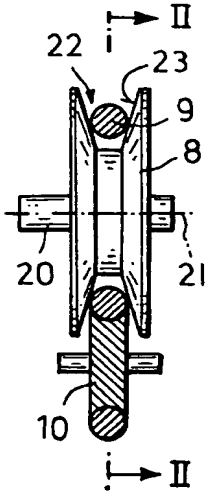


Fig. 3

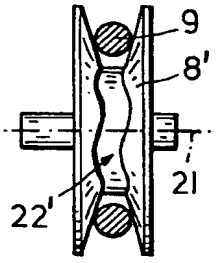


Fig. 4

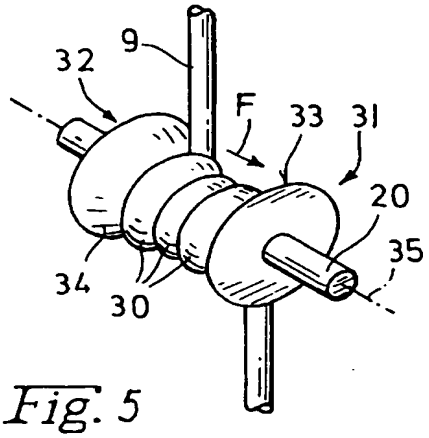


Fig. 5

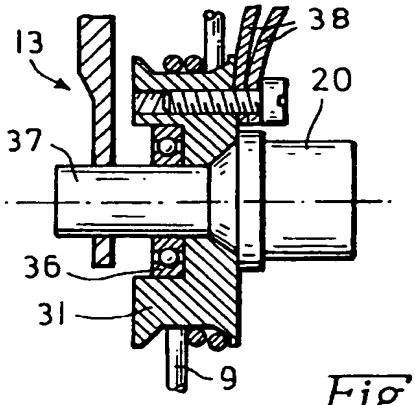


Fig. 6

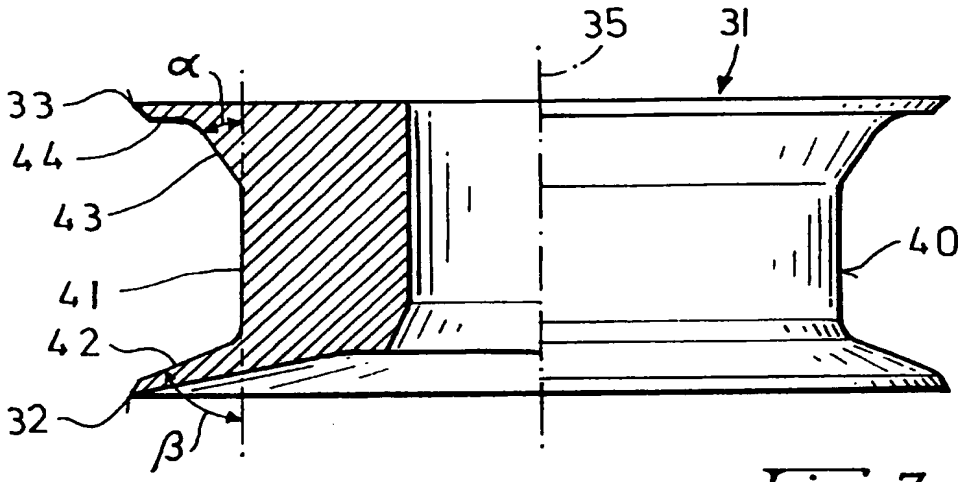


Fig. 7

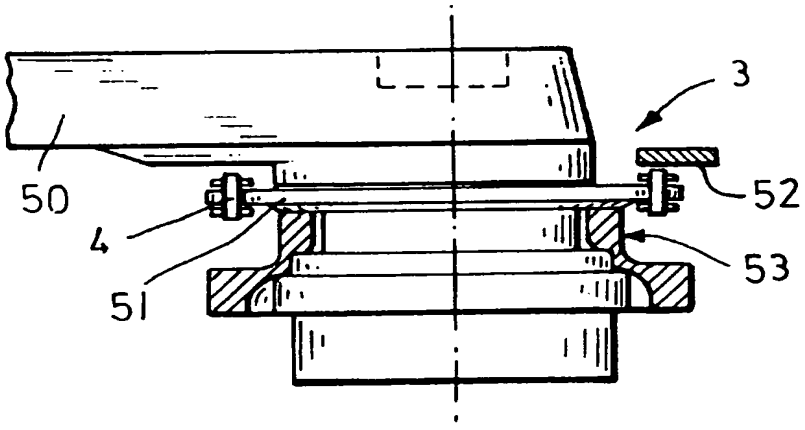


Fig. 8

BICYCLE CAPABLE OF VERTICAL MOTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a vehicle having at least one crankshaft drive capable of being actuated by muscular power, in particular a bicycle.

2. The Prior Art

Various bicycle designs are known from the state of the art, whereby such bicycles are designed in such a way that riding is possible only on horizontal or slanted grounds. It is basically impossible with known bicycles to ride in the vertical direction.

SUMMARY OF THE INVENTION

It therefore an object of the present invention to design a vehicle of the type specified above in such a way to enable vertical rides.

Due to the proposed friction gripping connection between the crankset drive of the bicycle and a substantially vertically-extending strand, the bicycle can move along the strand in the vertical direction. The strand, which is preferably a rope, chain or perforated belt, is secured at its top end on a fixing point, such as a building, preferably a tower, or a bridge. If suitable buildings are not available as fixing points, the top end of the strand can be secured on a crane. The stand is either freely suspended from such a fixing point or fixed at its bottom end as well.

A strand freely suspended at its bottom end offers the rider the additional thrill of swinging while he or she is riding which, however, also makes riding that much more difficult. Particularly when participating with such a bicycle in sport competitions, a freely suspended strand means that power and endurance are important, as well as the skill of the rider.

The friction gripping connection with the crankset drive, as opposed to a cable drum, provides for constant transmission ratios between the rate of revolutions of the crankset and the riding speed throughout the entire ride, because the strand is not wound up. Therefore, basically no derailleur gear is needed on the bicycle. However, when such derailleur gear is provided, the rider can select the speed suitable for given ride conditions, and retain that speed throughout the ride. This is important because the crankset drive of the vehicle is constantly highly stressed when riding in the upward direction, which makes throw-over of the drive chain to another chain ring and thus changing gear more difficult. However, changing gears while riding becomes superfluous due to the proposed design of the bicycle.

The friction gripping connection with the strand via a driven rotary element can be realized in a particularly simple way. No transmissions are required for translating the rotary motion of the crankset drive into other types of motion. The rotary element can be mounted directly on the shaft of the crankset, so that a conventional bicycle can be adapted to the new task with minimal expenditure. However, the rotary element is preferably non-positively connected with the rear wheel of the bicycle driven by the crankset, so that power is transmitted between the crankset and the rotary element via the drive chain of the bicycle. Any variable speed gear on the bicycle and the rear wheel brake can be jointly used in this way as well. Other types of transmission, for example by toothed gears, are of course conceivable as well. However, this would increase the re-equipping cost.

Providing for a variable speed gear offers the advantage that the bicycle can be easily adapted to different power and weight conditions of the rider. For example, a heavy-set beginner requires relatively low-gear transmission in order to be able to ride up the strand. On the other hand, a well-trained athlete will prefer high-gear transmission so as to be able to ride up at a faster speed. When a variable speed gear is used, the bicycle can be used universally.

A friction-grip type connection is advantageously formed by a capstan, which permits continuous passage of the strand in a particularly simple way. A capstan is a rotary element having a diameter expanding toward both axial ends. The strand enters the capstan rear of the widening diameter and loops around the capstan at least once, and preferably two to three times. The force generated between the entering strand and the capstan leads to displacement of the windings of the strand in the direction in which it runs off. This ensures that while riding, the strand always assumes the same position in relation to the capstan. This also ensures that the strand is looped around the capstan always in the same way, thus exerting a constant frictional force on the capstan.

A particularly favorable design of the capstan has a jacket surface having a diameter that widens at both ends and at different angles. The different pitch angles of the diameter-widening zones of the jacket surface of the capstan permit favorable adaptation of the capstan to the different loads during up and down rides. This capstan is arranged in such a way that when riding up the strand, the strand enters the capstan at its flatter end, and exits from the capstan at its steeper end. When riding down, the strand accordingly enters the capstan at its stepper end. This ensures that the lateral displacement forces acting on the strand are approximately the same when riding up and down the strand, in spite of considerable varying stresses acting on the strand.

In order to safely prevent the strand from sliding from the capstan, there is preferably a guiding surface extending at the end of the capstan perpendicular to its axis. Provision can be made for such a guiding surface at both ends of the capstan. However, alternatively, it may suffice if such a guiding surface is present only on the flatter end of the capstan. This measure ensures that the capstan has an adequate outside diameter at both of its ends for safely guiding the strand without having to design the capstan with unnecessarily great length.

As an alternative to a capstan, it is also possible to form the friction gripping connection by a driving disk. Such a driving disk keeps the strand seated and clamped in a groove extending all around, and in this way ensures sufficient friction gripping interaction with the strand in spite of the lesser looping angle. A V-shaped cross section has been successfully used for the groove because the strand, due to its tensile force, penetrates the groove just deep enough to obtain an adequate friction grip. In particular, the friction of the strand does not significantly depend on the diameter of the strand, so that when a thinner strand is used, no reduction in the friction of the strand is caused that would be hazardous to the rider.

So as to increase the friction of the strand further, the circumferential groove preferably has a corrugated shape. In this way, the strand seized by the driving disk is reversed a number of times in the axial direction of the disk, so that it is pressed even more forcefully against the groove of the driving disk, finding an increased frictional surface.

Fixing or pretensioning the bottom end of the strand increases the tensile force of the strand and thus serves to further increase the friction grip of the crankset with the

strand. This raises the gripping and holding safety, on the one hand, and makes it possible, on the other hand, to reduce the number of windings around the capstan. Furthermore, this measure stabilizes the strand in its position, which reduces lateral swaying of the bicycle with the strand. This simplifies riding along the strand and thus requires less skill on part of the rider.

As an alternative to a friction gripping connection, it is possible to form a positive connection by using a toothed gear engaging a chain, perforated belt, toothed belt, or toothed rack. This is slightly more costly than the friction gripping connection described above. However, a positive connection offers the special advantage that good power transmission is constantly ensured irrespective of the load, and thus regardless of which riding direction is selected. Therefore, the transmission of power between the bicycle and the strand is particularly safe and, furthermore, entirely independent of any external influences such as the weather.

Particularly when the friction gripping or positive connection between the bicycle and the strand is made on the crankset drive or rear axle of the bicycle, the problem arises that the center of gravity of the bicycle and rider is generally located above the point of engagement with the strand. The rider, therefore, is in an instable equilibrium, which requires such rider to be specially skilled in maintaining balance. So as to achieve a stable balance in this case, provision is made on the bicycle for a guide supported on the strand and extending above the center of gravity of the bicycle and rider. The top end of the guide thus forms a point of support, and the center of gravity of the system comprising the bicycle and the rider is located below this support point. The bicycle, therefore, is in a stable equilibrium, and the position of the bicycle varies only slightly around a position of balance without any action on the part of the rider. Preferably, the equilibrium is adjusted in such a way that the line of connection between the rear wheel and front wheel of the bicycle is inclined slightly upwardly.

The guide on the strand could be a roller secured on the bicycle and spaced therefrom; which seizes the strand with particularly low friction. As an alternative, it is proposed that the guide be a sliding part, as such a part can be manufactured in simpler ways as compared to a roller, and is also safer to use.

Designing the sliding part in the form of a tube is particularly safe, because the strand is guided enclosed in the tube and is thus not capable of jumping from the guide. Since a tube is inherently stable, no further retaining measures are required at its upper end, so that only the bottom of the tube needs to be secured on the frame of the bicycle. This results in a simple structure for the bicycle, so that few reconstruction measures are required to convert a conventional bicycle to one according to the invention.

Forming the tube into a curved shape permits guiding the strand around the rider in a particularly simple way, without causing any excessive friction between the strand and the tube. In addition, the tube can be lined on the inside with material having a smoothly gliding surface such as polytetrafluoroethylene, in order to further reduce friction with the strand. Furthermore, the rider is protected against the strand.

In order to avoid damage to the strand, the tube is flexible at its top end. In this way, the top end of the tube can compensate for any swaying movements of the bicycle, and thus prevent buckling of the strand. The flexible end piece ensures smooth entry of the strand into the tube and acts like a protective cable bushing, such as is known with plugs of electric cables. Buckling of the strand is a drawback not only because it may cause damage to the strand, but also in that any such kink would brake the ride, because the strand can no longer be smoothly inserted in the tube.

It is advantageous to provide a braking device on the bicycle. If the rotary element interacting with the strand is located on a wheel of the bicycle, the operating brake acting on such wheel can be applied directly. For increasing safety, it is preferred that at least one additional brake acting on the wheel of the bicycle or directly on the strand is provided. Such brake increases the safety of the rider and prevents any free fall if the operating brake of the bicycle fails. The brake device preferably acts in such a way that starting with a preset falling speed, it causes wedging on the strand, thereby retarding the falling motion. The brake device could be mounted on or in the tube.

Finally, it is preferable to equip the crankset drive with a freewheel or chain derailleur device in order to avoid forced rotation of the crankset when the bicycle is moving down the strand. This makes downward rides easier for the rider, as no pedalling is required.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and features of the present invention will become apparent from the following detailed description considered in connection with the accompanying drawings. It is to be understood, however, that the drawings are designed as an illustration only and not as a definition of the limits of the invention.

In the drawings, wherein similar reference characters denote similar elements throughout the several views:

FIG. **1** shows a lateral view of a preferred embodiment of the invention;

FIG. **2** shows a section through a driving disk with a reversing roller;

FIG. **3** shows a section through an arrangement according to FIG. **2** along line III—III;

FIG. **4** shows an alternative design of the driving disk;

FIG. **5** shows a three-dimensional view of a capstan;

FIG. **6** shows a section through the rear axle of the bicycle, the latter being equipped with a capstan;

FIG. **7** shows a section through a capstan; and

FIG. **8** shows a section through the crankset of the bicycle with a chain derailleur device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in detail to the drawings and, in particular, FIG. **1**, there is shown a bicycle **1** with a rider **2**. On bicycle **1**, provision is made for a crankset drive **3**, which can be put into rotation by rider **2**. The rotary motion of crankset **3** is transmitted to a rear wheel **5** of bicycle **1** by a drive chain **4**. For such transmission, rear wheel **5** has a number of toothed rims **6** forming a change-over gear **7**. It is possible in this way to adjust the transmission ratio between the rate of revolutions of crankset **3** and the rate of revolutions of rear wheel **5** in stages. Rear wheel **5** is actively connected with brake **5'**, which is required for a braked and thus safe ride down the strand.

A driving disk **8** is secured on rear wheel **5**. The rotary motion of rear wheel **5** is directly transmitted to driving disk **8**. Driving disk **8** is grippingly connected by friction with a strand **9** in the form of a rope, which extends substantially vertically. Driving disk **8** is partially looped by strand **9**

within a part zone, so that strand 9 is reversed. So that the downwardly leading section of strand 9 is realigned approximately vertically downwardly, strand 9 is reversed by a reversing roller 10, which in turn is supported on bicycle 1.

In order to obtain a stable balance for bicycle 1, strand 9 is guided in a tube 11 (shown by a sectional view), with the bottom end 12 of tube 11 being secured on bicycle frame 13. On the inside, tube 11 is coated with a gliding layer consisting of polytetrafluoroethylene in order to reduce the friction with strand 9. At its top end 14, tube 11 has a flexible end piece 15, which permits tube 11 to adapt to possible swaying movements of bicycle 1 without buckling strand 9. This ensures that strand 9 is smoothly fed into tube 11. Tube 11 is curved in such a way that it guides strand 9 around rider 2, so that the top end 14 of tube 11 is located above the center of gravity "S" of bicycle 1 and rider 2. This assures stable balance of bicycle 1. Bottom end 16 of strand 9 is pretensioned by means of a weight 17 in order to increase the frictional grip between strand 9 and driving disk 8. Alternatively, strand 9 can be secured at its bottom end 16 as well, such as by a spring.

FIGS. 2 and 3 show sectional representations of driving disk 8 and reversing roller 10. Driving disk 8 is mounted on shaft 20. Shaft 20 has an axis 21 that coincides with the axis of rear wheel 5 of bicycle 1. Driving disk 8 has a V-shaped groove 22, in which strand 9 is guided with frictioned gripping. V-shaped groove 22 is made narrow, so that strand 9 rests against flanks 23 of groove 22. In this way, strand 9, in accordance with its diameter, penetrates groove 22 just deep enough to provide it with adequate friction grip on flanks 23. Strand 9 loops around driving disk 8 by 180°, and accordingly is reversed from down to up. Such reversing of strand 9 is compensated by reversing roller 10, which is not driven. Roller 10 further reverses strand 9 by 180°.

FIG. 4 shows an alternative embodiment of driving disk 8'. Driving disk 8' has a V-shaped groove 22', which is corrugated in the axial direction. Rope 9 is forced in this way to deform itself in accordance with the corrugation of groove 22'. This results in a particularly solid frictioned gripping connection between driving disk 8' and rope 9, so that the looping angle between the two can be reduced, if need be.

FIG. 5 shows a three-dimensional representation of another embodiment for forming a friction grip connection with rope 9. In this embodiment, rope 9 is looped with three windings 30 around a capstan 31, which is mounted on shaft 20 of the rear axle of the bicycle. Capstan 31 is designed with diameters expanding toward both ends 32 and 33, so that rope 9 runs upon a conical surface 34 of capstan 31. In this way, the clamping force of rope 9 causes a pushing force "F" to act on rope 9, in the direction of capstan axis 35. This is important to prevent rope 9 from being wound on end 32 of capstan 31 as capstan 31 is turning, which would reduce the number of windings 30 of rope 9.

FIG. 6 shows a sectional view with a cut through capstan 31. Capstan 31 is torsionally rigidly mounted on shaft 20 of rear bicycle wheel 4, so that capstan 31 is driven and rotated by rear wheel 5. Via a ball bearing 36, capstan 31 is supported on a support shaft 37 forming part of bicycle frame 13. Spokes 38 of rear wheel 5 are secured on capstan 31 as well.

The shape of capstan 31 is clearly shown by the half-sectional representation according to FIG. 7. Capstan 37 has a capstan jacket surface 40, the center zone of which is formed by a cylinder surface 41. The diameter of capstan jacket surface 40 widens on both sides of the cylindrical surface 41 in the form of conical surfaces 42 and 43. Conical surfaces 42 and capstan axis 35 jointly enclose a larger angle a than the opposite conical surface 43 (angle β). Capstan 31 is mounted here in such a way that rope 9, when riding the bicycle up the rope, runs up on the flatter conical surface 43, as shown particularly in FIG. 6. This way, the load acting on the rope, which is considerably higher when bicycle 1 is riding up, is compensated, so that the forces of lateral displacement "F" acting on rope 9 are about the same when riding up and down the rope. So as to ensure an adequate end diameter of capstan 31 for safe rope guidance even with the flatter conical surface 43, capstan jacket surface 40 has, at the end of conical surface 43, a guiding surface 44 extending perpendicular to capstan axis 35. Provision for such guiding surface could be made at the other end of opposite conical surface 42 as well.

FIG. 8 shows a partly sectional view of a cutout of crankset 3. Crankset 3 consists of a crank 50, on which a pedal (not shown) is supported. Crank 50 is torsionally rigidly joined with a toothed rim 51, which is partly looped by drive chain 4. Drive chain 4 can be thrown into a groove 53 by means of a chain derailleur 52, so that the active connection between crank 50 and drive chain 4 is canceled this permits riding bicycle 1 comfortably down rope 9 without putting crankset 3.

Accordingly, while only several embodiments of the present invention have been shown and described, it is obvious that many changes and modifications may be made thereunto without departing from the spirit and scope of the invention.

What is claimed is:

1. A bicycle capable of traveling up and down a vertical strand and powered by muscular force of at least one rider, comprising a crankset drive in active positive connection with the strand, wherein the positive connection is formed by at least one rotary element at least partially looped by the strand, said rotary element being rotatable by said crankset drive and mounted on a shaft of the rear wheel of the bicycle.

2. A bicycle according to claim 1, wherein the crankset drive is equipped with a chain derailleur.

3. A bicycle according to claim 1, wherein the positive connection is formed by a variable speed gear.

4. A bicycle according to claim 1, wherein the positive connection is formed by at least one capstan looped at least once by the strand, said capstan being rotatable by said crankset drive around a capstan axis.

5. A bicycle according to claim 4, wherein the capstan has two axial ends and a jacket surface having a diameter that widens at said two axial ends at different angles of inclination.

6. A bicycle according to claim 4, wherein the capstan has two axial ends and a guiding surface on at least one axial end, said guiding surface extending perpendicular to the capstan axis.

7. A bicycle according to claim 1, wherein the positive connection is formed by at least one driving disk having a circumferential groove for clamping the strand, said groove being rotatable by said crankset drive.

8. A bicycle according to claim 7, wherein the groove extends around the entire circumference of the driving disk and is corrugated in an axial direction.

9. A bicycle according to claim 1, wherein the strand is tensioned at its bottom end by a weight for increasing the friction of the connection between the strand and the crankset drive.

10. A bicycle according to claim 1, wherein the strand is secured to the ground to increase the friction of the connection between the strand and the crankset drive.

11. A bicycle according to claim 1, wherein the strand is comprised of a chain, toothed belt or perforated belt and the positive connection is formed by at least one toothed gear rotatable by the crankset drive, and wherein the strand extends around the toothed gear.

12. A bicycle according to claim 1, further comprising a guide arranged on the bicycle and supporting the strand, said guide extending substantially above the center of gravity of the bicycle.

13. A bicycle according to claim 12, wherein the guide is a sliding part that seizes the strand.

14. A bicycle according to claim 12, wherein the guide comprises a tube extending above the center of gravity of the bicycle and rider, wherein the strand is glidingly supported within the tube.

15. A bicycle according to claim 14, wherein the tube is curved and guides the strand around and above the rider.

16. A bicycle according to claim 14, wherein the tube has a flexible top end.

17. A bicycle according to claim 1, further comprising a braking device mounted on the bicycle and connected to the strand and adapted to retard falling motions of the bicycle.

* * * * *

US005577750A

United States Patent [19]

Sklar

[11] Patent Number: 5,577,750

[45] Date of Patent: *Nov. 26, 1996

[54] **BICYCLE STABILIZING FLEXPOLE TRAINER**

[76] Inventor: Lyle W. Sklar, 4210 NW 26th Ct., Boca Raton, Fla. 33434

[*] Notice: The terminal 10 months of this patent has been disclaimed.

[21] Appl. No.: 272,663

[22] Filed: Jul. 11, 1994

Related U.S. Application Data

[63] Continuation of Ser. No. 43,896, Apr. 7, 1993, abandoned.

[51] **Int. Cl.**[6] **B62H 7/00**

[52] **U.S. Cl.** **280/293**; 280/288.4

[58] **Field of Search** 280/293, 294, 280/296, 298, 288.4, 292, 295, 47.131, 755, 213; 403/373, 399, 379, 200

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Primary Examiner—Anne Marie Boehler
Attorney, Agent, or Firm—Oltman, Flynn & Kubler

[57] **ABSTRACT**

A bicycle stabilizing flexpole trainer, removable attachable to the rear of a bicycle frame, adjacent its center of gravity. The trainer defines an elongated flexible tubular balancing pole having a free upper end, an intermediate section and a reinforced anchor engageable lower end. An adjustable pole anchor clamp and connector plate to secure the end of the pole to the frame of the bicycle. The clamp forms opposed plates, engaging the frame in compression contact. The clamp upper plate includes legs extending downwardly of the clamping assembly to confine the lower plate against displacement.

1 Claim, 2 Drawing Sheets

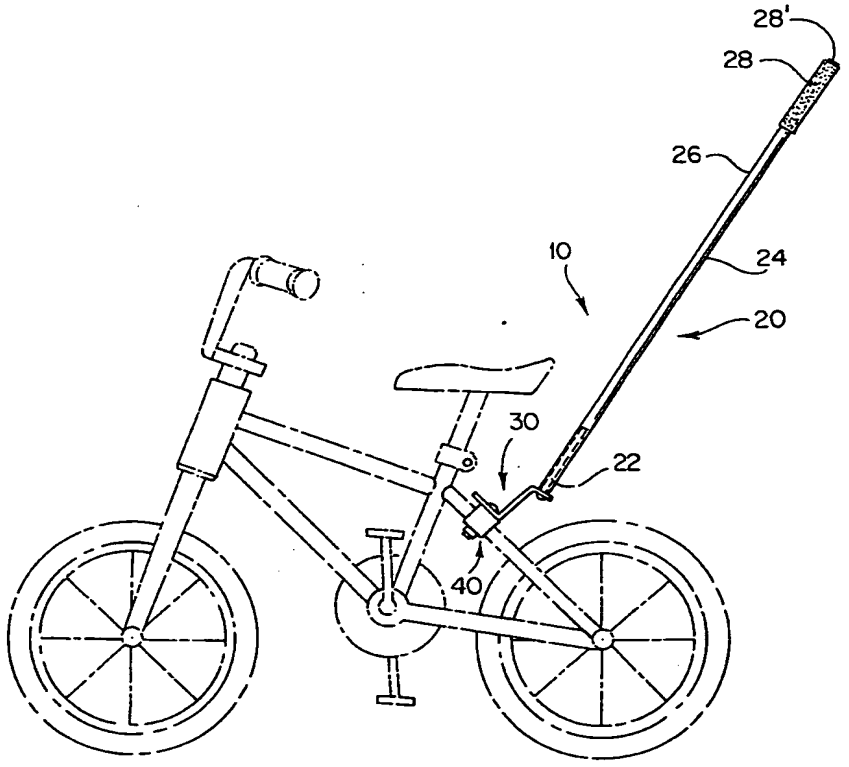
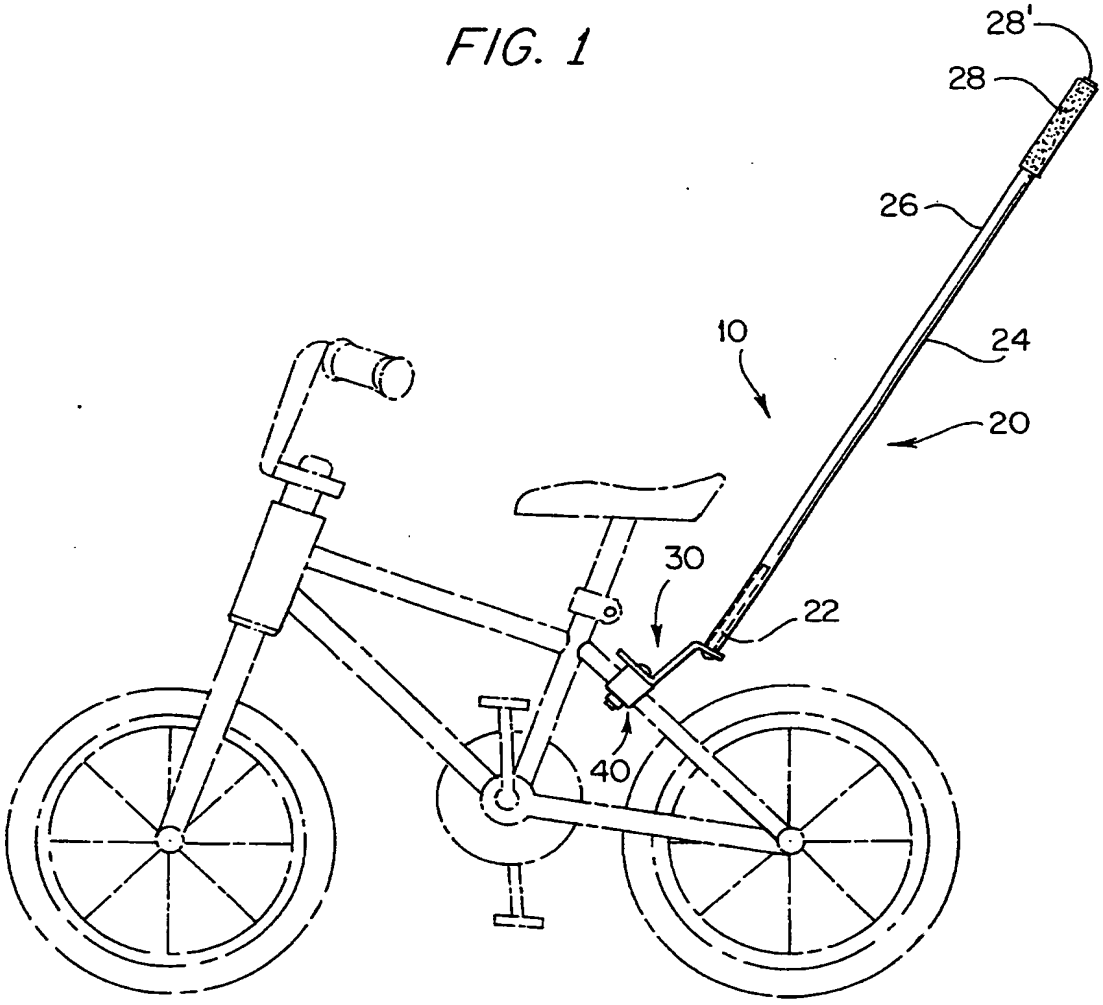


FIG. 1



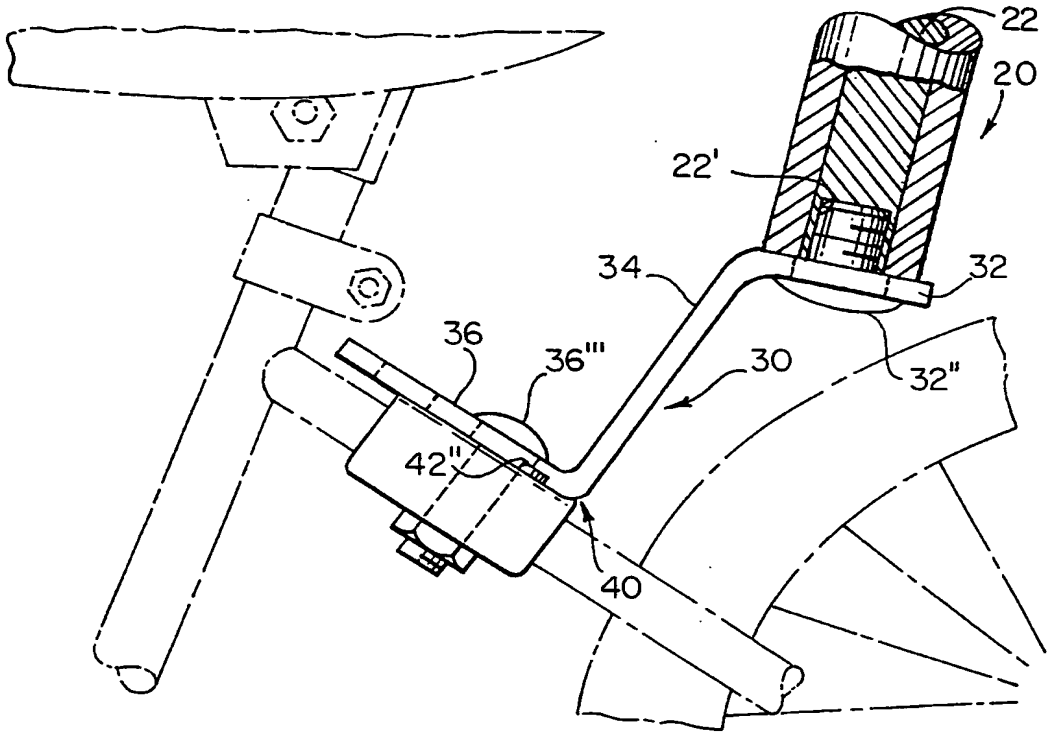

22
20
22'
34
32
36
36'''
30
32"
42"
40

FIG. 2

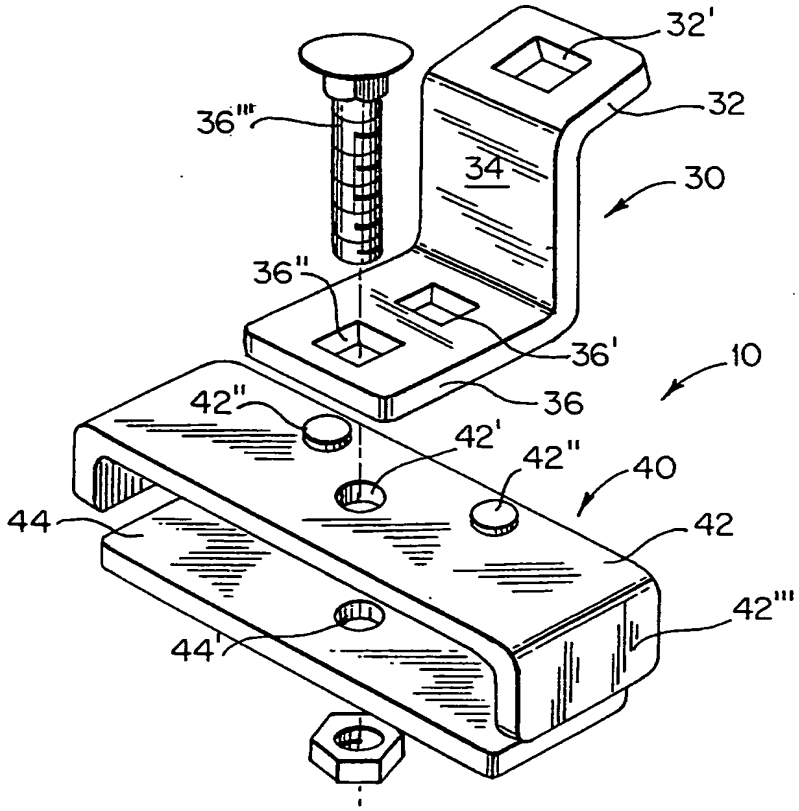

32'
32
36'''
34
30
36"
36'
10
42"
36
42'
42"
40
44
42
42'''
44'

FIG. 3

BICYCLE STABILIZING FLEXPOLE TRAINER

This application is a continuation of application Ser. No. 08/043,896, filed Apr. 7, 1993 now abandoned.

BACKGROUND OF THE INVENTION

Up to the present, to support the novice, trainee bike rider, the adult had to grip onto either the seat of the child or the seat of the bike. Often he/she must have another hand on the handle bar to help steer. This may lead to injury to both child and adult. More recently, children learning to ride bicycles have required addition to the bicycle of a set of training wheels, thus presenting support and stability to the vehicle when the novice is mounted; when training wheels are removed, problems develop for the adult who is assisting in the learning process. This abnormal bending position which the adult assumes while guiding and running along, supporting the child can lead to back strain. Also, the rear bike wheel often presents a stumbling block. It is ideal for the adult to balance the bike while located directly behind it, so as to be in perfect position to react if the bike begins to lean uncontrollably to the left or the right. The present invention eliminates bending and provides a stable support which the adult can grip to stabilize the bicycle and child while positioning the adult behind the child and rear wheel. Also, when the adult is behind the bike, the height of the present pole with the guiding grip at the top visually amplifies any erratic tilting motions of the child or the bike and one can thus anticipate the need to grab on or get a better grip on the pole, quickly before the child completely loses balance. Accordingly, the present invention provides an alternative that is not currently available when one makes the decision to remove a child's training wheels. Installation and removal of the pole is by hand tightening and loosening; no tools being required. The vice-like clamp is easily removed with pliers or wrench to loosen a simple nut.

The present invention provides a most convenient transition from bicycle training wheels. A custom retrofitted extension pole is used by the adult to balance the bicycle. It is secured to the upper rear wheel fork by a readily detachable mount. This innovation thus provides a simple, inexpensive and removable or replaceable stabilizing unit. As a so-called BIKE STICK (™), it is a uniquely mounted extension pole, manually engaged by an adult to balance a bicycle while a child learns to ride, without training wheels. Whereas, the adult using the BIKE STICK (™) avoids bending over and back strain; the invention it helps an adult assist a child in developing balance, confidence, the ability to lean into turns, and achieve speed control. Falls, collisions, injuries and fear can all be reduced when learning to ride a bike with this balance BIKE STICK. (™).

THE PRIOR ART

The most notable earlier developments herein are represented by the following United States Letters Patent:

INVENTOR	DATE	U.S. Pat. No.	TITLE
Kane	1952	2,672,351	HANDLE FOR PUSHING TRICYCLE
Cassell	1972	3,650,544	BICYCLE STABILIZER
De Miranda Pinto	1990	4,917,398	BICYCLE TRAINING HANDLE

Each of the aforesaid, is deficient in terms of facility of installation and/or removal, and each is economically unfeasible, comparative to the present BIKE STICK (™) assembly.

SUMMARY OF INVENTION

In its broadest form, the invention comprises a removable and replaceable retrofitted training stabilizer for bicycles. The unit may likewise be adapted to related vehicles wherein balancing must be imposed adjacent the center of gravity of the vehicle; when the rider attempts to develop balance during propulsion of the unit, and even when it may be at a standstill. The conventional bicycle frame characteristically is in the form of an isosceles triangle from the forward apex of which depends a U-frame for the maneuverable front wheel and upon which is mounted a steering handlebar. From the rear apex and at the base of the frame are two fork supports which sustain the rear driving wheel in relation to the frame. The propulsion pedals and gears are conventionally located for interconnection with the driving wheel, etc. When occupied, the bicycle center of gravity, while shiftable, is generally located midway between front and rear wheels, in-line with the seatpost, perhaps more accurately stated to be at a vertical C/G line which is immediately forward of the rear driving wheel. Thus, the present stabilizer is set to complement the effect of the normal mounted center of gravity. This stabilizer is accordingly set adjacent the upper portion of the bicycle frame, close to the C/G and extends angularly upward therefrom, between the upper bifurcated rear wheel fork, close to the seatpost. It is fixed to the frame in an adjustable way so that it may accommodate bicycles having banana seats of various lengths and other configurations of the rear fork as will be more fully explained hereinafter.

Advantages achieved through the adaptation of invention include the following. The BIKE STICK (™) clamp comprises three plates all held together and secured to the bike by a single carriage bolt and nut. Stability of the three part clamp is enhanced by the vice-like clamping effect of anchor elements upon the upper rear fork of the frame. Installation and removal of the exterior pole onto the clamp requires no tools and involves only hand tightening of the pole. The exterior pole itself is secured to the clamp at its lower end by an axial bore contained in a solid rod-like insert that provides a threaded seat for an anchor bolt. The pole and insert, thus tighten onto a non-rotating carriage bolt. The position of the anchorage of the pole is between the front and rear wheels, close to the seat tube which is very close to the bicycle center of gravity. The pole position and angle permits the trainer to be positioned directly behind the bike. The flexibility of the pole itself is such that it allows the child rider limited freedom of motion to balance, without the adult user giving up his/her grip on the pole. The pole insert also provides rigidity to the flexible pole adjacent the critical area of anchorage to the clamp.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in side elevation of the invention unit, wherein the vehicle is at rest and balanced.

FIG. 2 is an enlarged partial view in side elevation of the FIG. 1 configuration, the unit being applied to an A-frame bike rear upper fork.

FIG. 3 is a view in perspective of the FIGS. 1 & 2 clamp assembly.

DESCRIPTION OF PREFERRED EMBODIMENTS

BIKE STICK (™) unit **10** is an assembly which comprises a flexpole **20**, intermediate anchor plate **30**, with bolts and changing assembly **40**.

The flexpole **20** has an anchor end wherein a rigid rod-like solid insert **22** is plastic welded into the lower portion of the pole and this insert has a threaded seat **22'** for an anchor carriage bolt **32"**. Intermediate segment **24** terminates in upper end **26** to which is friction filled a handle sleeve **28**, capped at **28'** to enclose the pole end. Flexpole **20** may be compared to a PVC tube, which is open at both ends, the lower end providing a threaded housing for the anchor carriage bolt, defined hereinafter.

Upper connector plate **30** defines an inclined rearward ledge segment **32**, an upright, intermediate elevating segment **34** with flat lower segment **36** which together provide elevation to inclined ledge **32** to clear the bike caliper brakes while avoiding interference with bike seat and/or rear tire. This first segment **32** defines bore **32'** which seats carriage bolt **32"** therein for anchorage to the flex pole. An oversized washer may prevent abrasion of the PVC tube against upper plate shelf **32**. The flat lower segment **36** is at a right angle to segment **34** and extends forwardly thereupon. It defines two front and rear bores **36'** and **36"** which adjustably seat the carriage bolt assembly **36"'** which includes a nut.

Clamping assembly **40** includes middle plate **42** and bottom plate **44**. A central bolt apertures **42'–44'** are aligned to receive bolt **36"'** as shown. On the top surface of plate **42** are a pair of laterally disposed half shears **42"** to engage sides of the lower most segment of the connector plates preventing rotation of contiguous segment **36** thereon. In lieu of the half-shears, one may simple provide protuberances in the form of parallel ridges, not shown. Laterally depending legs **42"'** will retain the bottom plate and provide a restorative housing to guard against displacement of the entire unit **10** on the bike frame. Carriage bolt **36"'** is compressibly fitted to assemblies **30** and **40** by means of the bolt assembly nut which engages the lower surface of plate **44** beneath the aperture **44'** thereof. It is significant that the apertures **32'**, **36'** and **36"** be polygonal in cross section to preclude slippage of the bolts in their corresponding seats.

Characteristically, the disposition of the extension pole stabilizer unit **10** relative to the frame, the bike seat and the wheel of the vehicle, is such that the balancing unit is most effectively disposed relative to the mean center of gravity of the bike when it is occupied and being used. Whereas the center of gravity will shift upon acceleration and the change in vehicle pitch, the location of the BIKE STICK (™) unit close to the mean center of gravity suffices. The flexibility of the pole is such that it allows the child rider limited freedom of motion to balance, without giving up one's grip on the pole.

Whereas the invention has been described with specific reference to the drawings, various modifications may be made without departing from the spirit of the invention, defined in the annexed claims.

I claim:

1. A bicycle stabilizing training apparatus, for use on a bicycle having a front end and a rear end and having a frame including a front wheel having an axle and a rear wheel having an axle, and further including a seat and a seat supporting member and a rear wheel mounting fork extending from said seat supporting member to said axle of said rear wheel, and having a combined center of gravity when mounted by a bicycle rider, comprising an elongate balancing pole member comprising a pole member first end for mounting to said bicycle frame and a pole member second end adapted to be gripped as a handle, said pole member being adapted to function as a lever for a trainer behind said bicycle to grasp and hold and thereby to support, propel, balance and stop said bicycle, and to release and re-grab said handle and recover balance for allowing the rider to test his or her riding ability without falling,

pole member mounting means adapted to secure said pole member to said rear wheel mounting fork adjacent said seat supporting member, such that said pole member mounting means is located near said combined center of gravity for creating a maximum moment at said pole member second end about said combined center of gravity,

wherein said pole member is tilted toward said rear end of said bicycle and extends to a point behind said axle of said rear wheel to permit said trainer improved access to said pole member,

wherein said pole member mounting means comprises an adjustable anchor clamp engaging said rear wheel mounting fork to support said pole member, said anchor clamp comprising opposed upper and lower anchor plates having fastening means urging them into compression contact with said rear wheel mounting fork,

a connector plate joining said anchor clamp and said first end of said pole member, said connector plate having connector plate fastening means securing said connector plate to said pole member,

wherein said connector plate defines a topmost rearwardly inclined ledge segment, an elevating segment extending below said ledge segment and a forwardly extending lowermost segment, wherein said inclined ledge segment provides a perpendicular contact for said pole member, said elevating segment spacing said pole member apart from said bicycle frame, said lowermost segment providing means for positioning of said connector plate on the anchor clamp,

wherein said upper anchor plate exceeds said lower anchor plate in lateral dimension and has leg portions depending therefrom, said leg portions providing a retaining structure for said lower plate, whereby to confine said lower plate against displacement relative to said upper anchor plate and to confine said mounting fork to prevent lateral displacement of said anchor plate relative to said frame.

* * * * *

United States Patent [19]

Kobayashi

[11] **Patent Number: 4,893,579**

[45] **Date of Patent: Jan. 16, 1990**

[54] **COMPACT PLANING TYPE BOAT**

[75] Inventor: **Noboru Kobayashi, Iwata, Japan**

[73] Assignee: **Yamaha Hatsudoki Kabushiki Kaisha, Iwata, Japan**

[21] Appl. No.: **237,505**

[22] Filed: **Aug. 26, 1988**

[30] **Foreign Application Priority Data**

Aug. 28, 1987 [JP] Japan 62-213010

[51] **Int. Cl.**[4] **B63B 35/86**

[52] **U.S. Cl.** **114/363**; 114/270; 297/195

[58] **Field of Search** 114/343, 361, 362, 363, 114/355, 356, 357, 270; 440/38; 297/195, 214

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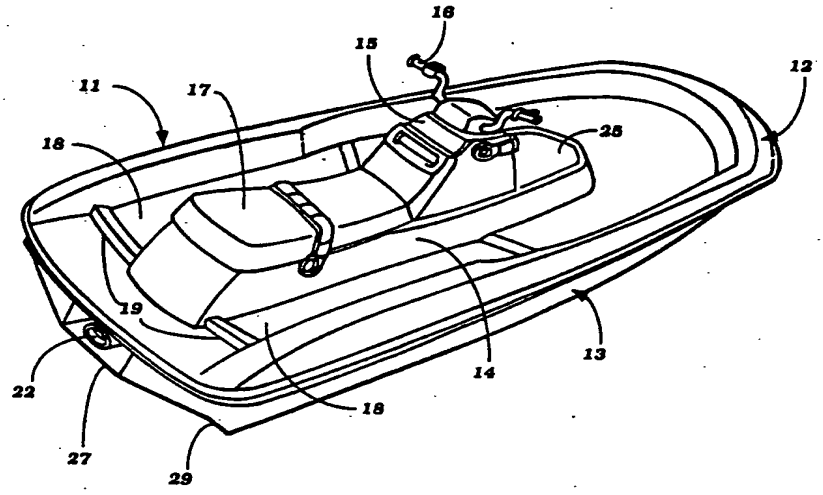
Primary Examiner—Joseph F. Peters, Jr.
Assistant Examiner—Edwin L. Swinehart

[57] **ABSTRACT**

A hull configuration for a small watercraft that provides a tandem straddle type seating arrangement to the rear of a bridge on which the steering handle is formed. In addition, a forward seat is also provided and the hull is configured so that the buoyancy increases if a rider shifts to the forward seat so as to maintain a generally horizontal stability for the watercraft under all conditions.

7 Claims, 5 Drawing Sheets



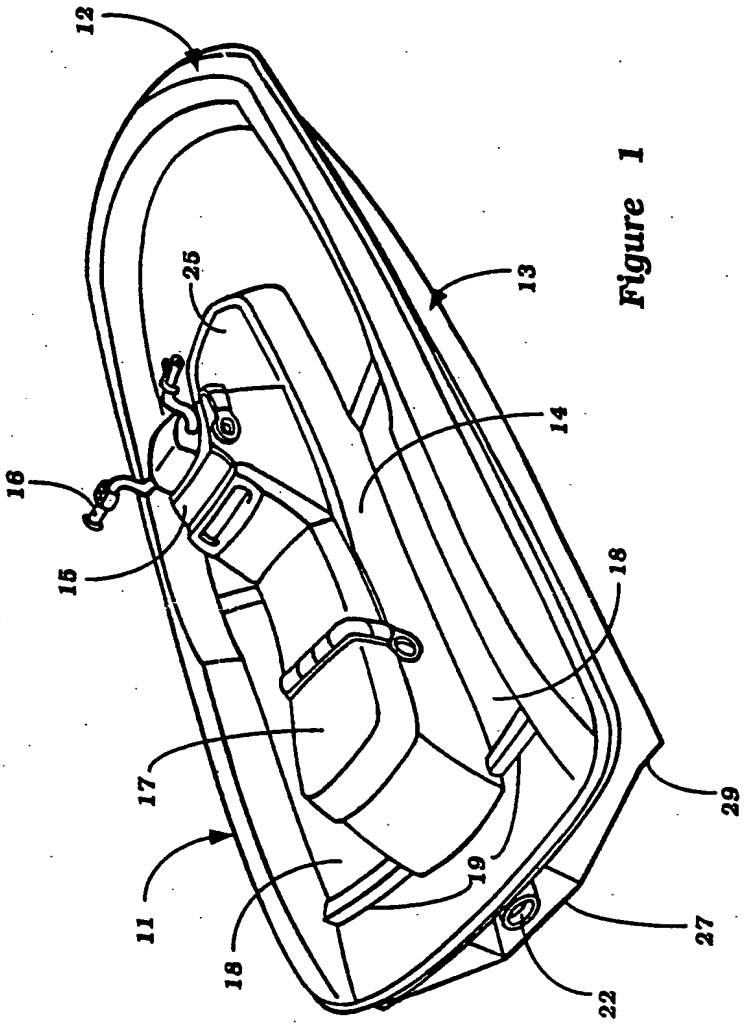


Figure 1

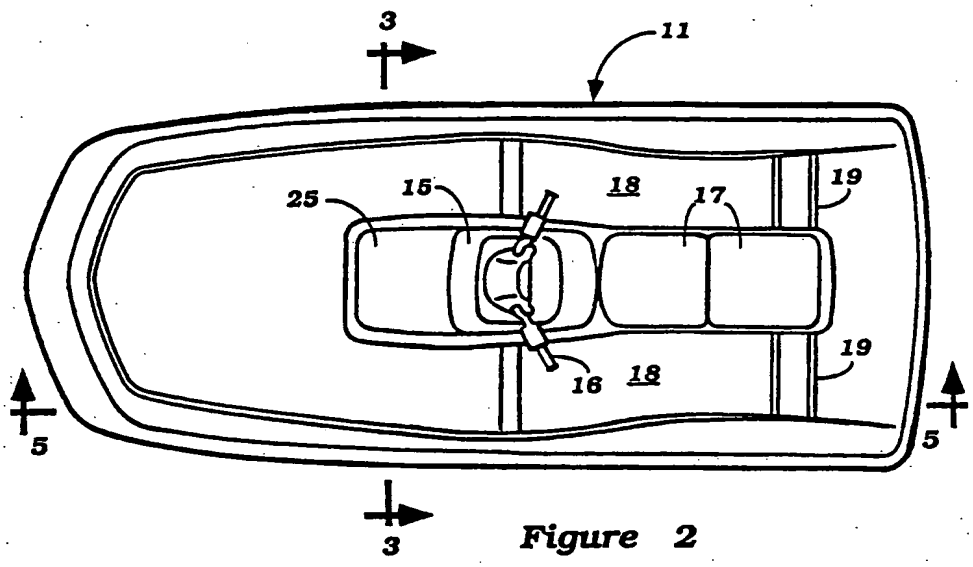


Figure 2

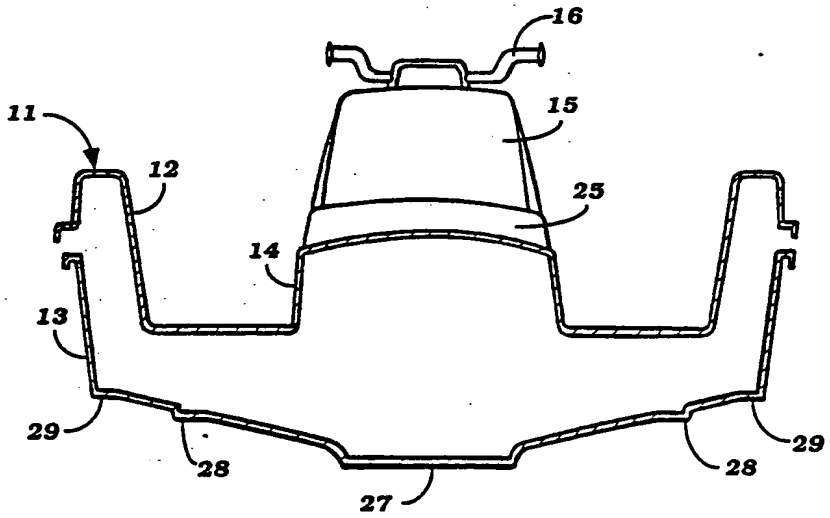


Figure 3

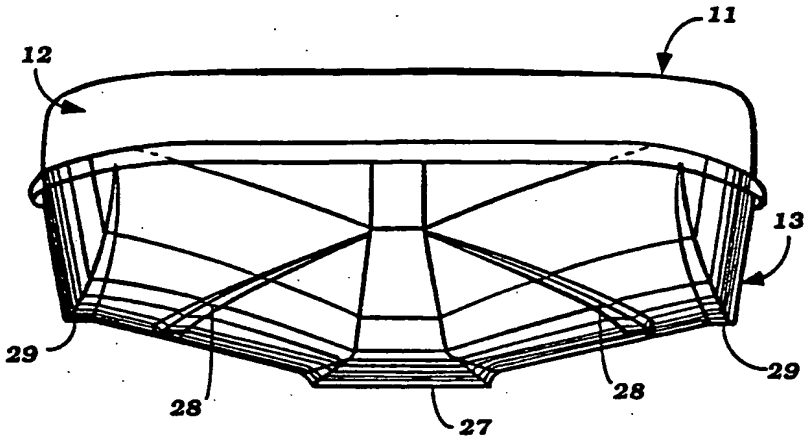


Figure 4

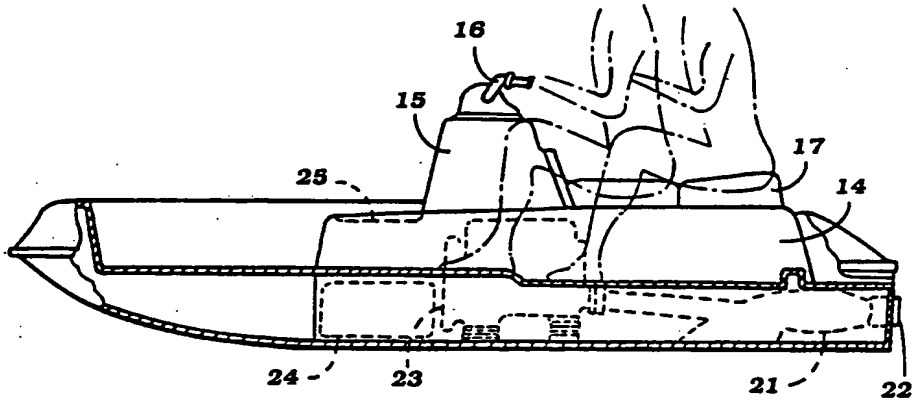


Figure 5

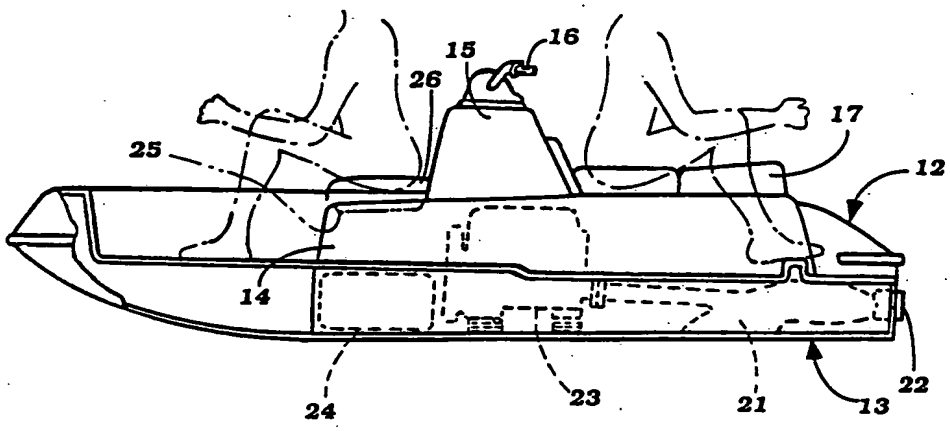


Figure 6

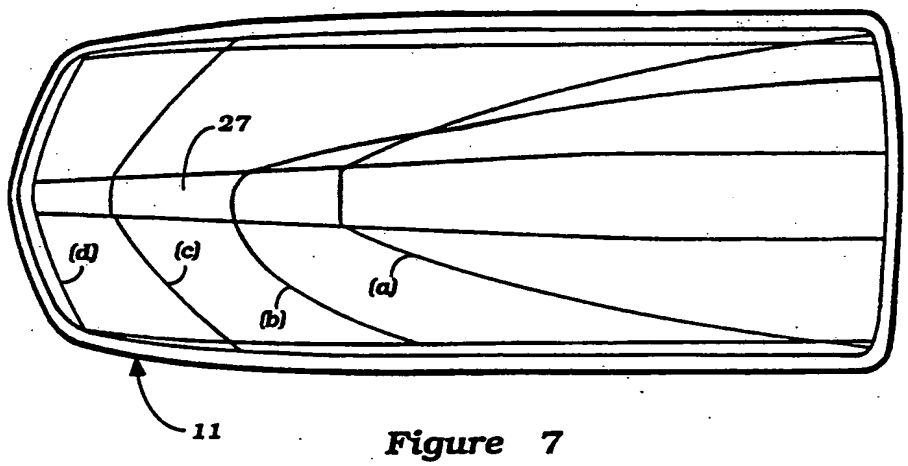


Figure 7

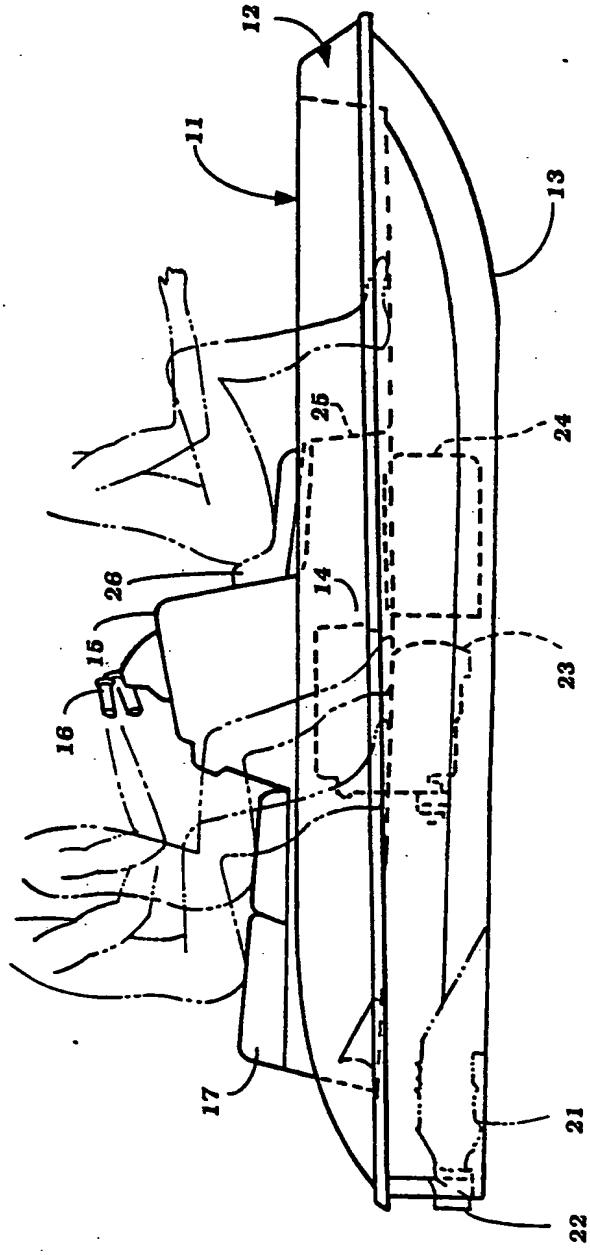


Figure 8

COMPACT PLANING TYPE BOAT

BACKGROUND OF THE INVENTION

This invention relates to a compact planing type boat and more particularly to a high performance watercraft that is highly versatile.

There recently has been a great degree of popularity in a compact planing type of boat in which the driver and his passenger sit in straddle, tandem fashion upon a set that is positioned directly behind the steering tiller. This form of watercraft is commonly powered by a jet propulsion unit and has very sporting type performance. Although this type of watercraft is excellent for sport riding, the tandem seating position does not offer particular utility for other pleasure activities such as fishing or the like. In addition, the hull configuration of this type of watercraft is such that when there is any substantial forward weight bias, such as if a rider wishes to sit in front of the steering tiller, or, alternatively, if the watercraft is entered or exited from the front, the stability of the watercraft decreases significantly.

It is, therefore, a principal object of this invention to provide an improved compact planing type of watercraft.

It is a further object of this invention to provide a compact planing type of watercraft of this general type which will offer wider versatility then conventional watercraft of this type.

It is a further object of this invention to provide an improved hull configuration for this type of watercraft wherein the watercraft has its versatility substantially increased.

It is a further object of this invention to provide a hull for a watercraft of this type that facilitates riders sitting in either tandem fashion or in fore and aft fashion relative to the steering tiller.

SUMMARY OF THE INVENTION

This invention is adapted to be embodied in a hull configuration for a watercraft having a bow portion, an intermediate bridge portion, supporting means for steering the watercraft and a stern portion. Means provide a rear seat seating at least two riders in the stern portion in straddle, tandem relationship to the rear of the bridge so that the forwardmost rider may steer the watercraft. Means provide a forward seat for at least one of the riders in the bow portion forwardly of the bridge. The unladen center of gravity of the hull is juxtaposed in a longitudinal direction in proximity to the bridge. The hull is configured so that the hull assumes a generally upwardly inclined position when riders are seated in tandem fashion on the rear seat and the hull is travelling forwardly at speed. The hull further is configured to assume a substantially horizontal condition when the watercraft is not travelling and riders of approximately equal weight are seated respectively on the forward and rear seats at approximately equal distances from the bridge.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a small watercraft constructed in accordance with an embodiment of the invention, viewed from above and from the rear.

FIG. 2 is a reduced scale, top elevational view of the watercraft.

FIG. 3 is an enlarged cross-sectional view taken along the line 4—4 of the watercraft.

FIG. 4 is an enlarged front elevational view of the watercraft showing primarily the bow portion and hull configuration in this area.

FIG. 5 is cross-sectional view taken along the line 5—5 of FIG. 2 showing two riders seated in tandem fashion on the rear seat.

FIG. 6 is a side elevational view, with portions broken away, similar to FIG. 5 but showing one rider seated on the rear seat and one rider seated on the front seat.

FIG. 7 is a bottom plan view of the watercraft showing the contact patches of the hull with the water under various riding conditions.

FIG. 8 is an enlarged side elevational view showing the configuration of the watercraft and its angle in the water under a variety of conditions.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring now in detail to the drawings, a small watercraft constructed in accordance with an embodiment of the invention is identified generally by the reference numeral 11. The watercraft 11 is comprised of a hull, which may be formed from molded fiberglass or the like and which is comprised primarily of an upper hull portion, indicated generally at 12 and a lower hull portion, indicated generally at 13. The hull portions 12 and 13 are affixed to each other in any suitable manner. In addition, certain hollow areas of the hull may be filled with buoyancy material so as to provide the desired buoyancy and the flotation characteristics, in combination with the hull configuration, as will be hereinafter described.

The upper hull portion 12 is provide with a raised central area 14 which also defines a centrally positioned bridge 15. The bridge 15 extends upwardly from the remainder of the portion 14 and accommodates a steering handle 16 for steering the watercraft in a manner to be described.

Rearwardly of the bridge 15, the raised hull portion 15 accommodates a seat 17 that is designed so as to accommodate a pair of riders seated in straddle, tandem fashion as best shown in FIGS. 5 and 8. On opposite sides of the seat 17, the hull upper portion 12 is provided with a pair of longitudinally extending depressed footwell areas 18 into which the riders may place their legs when so seated on the seat 17. Rearwardly of the footwell portions 18 there is provided a pair of transversely extending ribs 19 which serve the primary function of preventing the intrusion of water into the footwell area 18.

In the illustrated embodiment, the watercraft 11 is of the jet propelled type and for this purpose a jet propulsion unit 21 is disposed in a recess formed in the underside rear portion of the lower hull portion 13. The jet propulsion unit 21 may be of any known type and has a pivotally supported discharge nozzle 22 that is adapted to be steered by the steering handle 16 for steering the watercraft 11 in a known manner. An engine, shown in phantom and which may of any type, is identified generally by the reference numeral 23 and is positioned forwardly in the hull in a position generally beneath the bridge portion 15. The engine 23 drives the jet propulsion unit 21 in any known manner. In addition, a fuel tank and battery assemblage, indicated generally by the

reference numeral 24 may be positioned in the hull forwardly of the engine 23 and below a forward seat portion 25 defined by the raised upper hull portion 14. A removable hatch (not shown) may be carried by the portion 25 so as to permit access to the engine 23, fuel tank and battery 24 and for other servicing functions. A seat cushion 26 (FIGS. 6 and 8) can be removably supported on the portion 25 so as to afford a comfortable seating position for a rider forwardly of the bridge 15 under certain circumstances, as will be described.

It should be noted that the configuration of the hull, its buoyancy and the location of the principal mass units is such so that the center of gravity CG is located longitudinally of the watercraft in the position of the bridge 15 and just slightly rearwardly of the steering handle 16 when the watercraft is not mounted by any riders. The center of gravity is also positioned on a longitudinal center line CL of the watercraft. The reasons for this will become apparent as the description proceeds.

The configuration of the hull is such that it has a relatively broad keel that extends along a base line BL from the rear of the watercraft forwardly to a point approximately midway between the front of the bow and the vertical center line VL. From there, the hull curves upwardly but it has a generally shallow V configuration as best shown in FIG. 3. The central portion of the hull is generally flat as indicated at 27 and then the sides incline upwardly at the shallow V angle and a pair of stripes 28 are formed outwardly that extend in a generally longitudinal direction along the rear and front portions of the hull until the hull begins its upward curvature. At this point, the stripes 28 curve inwardly as best shown in FIG. 4. In addition, the outer edges of the hull are provided with a pair of chines 29 that serve the function of providing stability and resistance to large degrees of leaning under extreme conditions. The stripes 28 on the other hand, function to assist in steering under condition as will now be described.

FIG. 5 shows the normal condition of the watercraft when travelling at speed. In this condition, the two riders are seated in tandem fashion on the rear seat 17 behind the bridge 15. The forwardmost rider has access to the steering tiller 16 for steering of the watercraft in the aforedescribed manner. When operating under this condition, the center of gravity (CG) moves rearwardly to the point shown in FIG. 7 and the hull will be in a planing condition wherein the water patch contact with the lower portion of the hull is indicated by the line a. This offers good high speed running stability and maneuverability. If desired, the steering of the watercraft, particularly under sharp turn conditions, may be improved by the riders leaning forwardly and into the direction of the turn. The contact patch with the water will then assume the conditions shown by the line b and the stripes 28 will assist in sharp turning.

In FIG. 8 the water level during planing conditions is indicated by the line a and it will be seen that under this condition there is a relatively shallow draft and very little of the forward or bow portion of the hull is in contact with the water so that high speeds are possible while maintaining stability and good handling, as aforenoted.

In the event forward travel is stopped, the watercraft will sink down into the water to some extent and assume a condition as shown by the line c wherein the watercraft is slightly more submerged to the rear than to the front. The contact patch 1c shows how the water contacts the hull under this condition. It should be noted that the shallow V angle tends to cause the buoyancy of the forward portion of the hull to increase as the watercraft settles into the water so as to prevent nosediving of the boat under this condition.

In the event a rider wishes to sit in the forward portion of the boat, for example for fishing, he may transfer to the forward seat 26 as shown in FIG. 6. Assuming that both riders have approximately equal weight, the watercraft will assume a very balanced condition relative to the center of gravity because the seat 26 and the forward portion of the rear seat 17 are disposed at the same distances $\frac{1}{2}$ from the center of gravity. Under this condition, the watercraft will assume nearly a horizontal condition as shown by the line d in FIGS. 7 and 8 and very high stability will result. This also assists in dismounting of the watercraft from the front without having the front portion become submerged.

It should be readily apparent, therefore, that the described hull configuration and seating configuration add significantly to the stability of the watercraft under a wide variety of conditions without adversely affecting high speed performance. Although an embodiment of the invention has been illustrated and described, it is to be understood that this is only a preferred embodiment and that various changes and modifications may be made without departing from the spirit and scope of the invention, as defined by the appended claims.

I claim:

1. A hull configuration for a watercraft having a bow portion, an intermediate bridge portion, supporting means for steering said watercraft, and a stern portion, a rear seat for seating at least two riders in said stern portion in straddle, tandem relationship to the rear of said bridge portion so that the forwardmost rider may steer said watercraft, and a forward seat for one of said riders in said bow portion forwardly of said bridge portion, a depressed foot area around a front portion and side portions of said forward seat and side portions of the rear seat and said bridge portion for placement of the riders feet, the unladen center of gravity of said hull being juxtaposed in a longitudinal direction in proximity to said bridge, said hull being configured such that said hull assumes a generally upwardly inclined position when riders are seated in tandem on said rear seat and said hull is travelling forwardly at speed and in a substantially horizontal condition when said watercraft is not travelling and riders of approximately equal weight are seated respectively on said forward and rear seats at approximately equal distances from said bridge.

2. A hull configuration for a watercraft as set forth in claim 1 wherein the forward portion of the hull shape is configured to provide substantially increasing buoyancy as the forward portion of the hull is urged to a submerged position.

3. A hull configuration for a watercraft as set forth in claim 2 wherein the hull is formed with a pair of longitudinally extending stripes that extend parallel to the longitudinal center line of the watercraft on opposite sides thereof from the stern forwardly of the bridge portion and wherein they curve inwardly toward the center line as approaching the bow.

4. A hull configuration for a watercraft as set forth in claim 3 wherein the outer portion of the hull is provided with a pair of chines that have a configuration generally paralleling that of the stripes.

5. A hull configuration for a watercraft as set forth in claim 4 wherein the forward portion of the hull has a generally shallow V shaped configuration.

6. A hull configuration for a watercraft as set forth in claim 1 wherein the watercraft is powered by an engine disposed beneath the bridge portion so as to concentrate the center of gravity in the area of the bridge portion.

7. A hull configuration for a watercraft as set forth in claim 6 further including buoyant mass means formed at the sides of the hull.

* * * * *

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United States Patent [19]

Howell et al.

[11] Patent Number: 5,501,476

[45] Date of Patent: Mar. 26, 1996

[54] **MUSCLE POWERED THERAPEUTIC VEHICLE**

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[73] Assignee: **University of Utah Research Foundation**, Salt Lake City, Utah

[21] Appl. No.: **376,128**

[22] Filed: **Jan. 19, 1995**

Related U.S. Application Data

[63] Continuation of Ser. No. 888,724, May 26, 1992, abandoned.

[51] **Int. Cl.**[6] **B62M 1/04**

[52] **U.S. Cl.** **280/230**; 280/256; 280/290; 297/215.12; 482/57

[58] **Field of Search** 280/288.4, 252, 280/253, 256, 290, 200, 223, 224, 230, 233, 259, 262; 297/DIG. 9, 466, 383; 482/51, 57, 62

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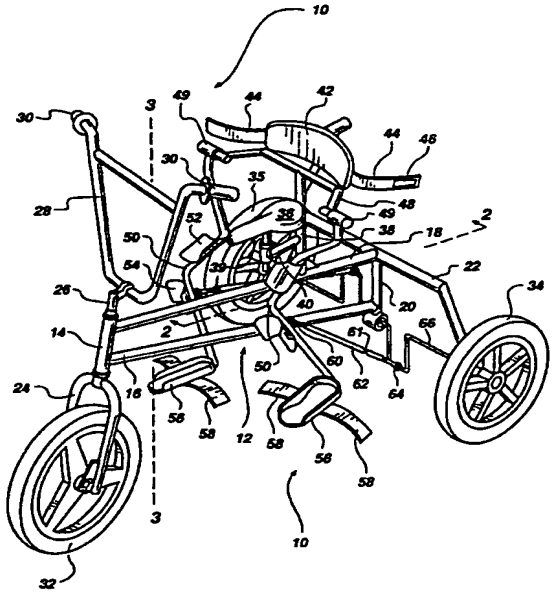
Attorney, Agent, or Firm—Thorpe, North & Western

[57] **ABSTRACT**

A therapeutic wheeled vehicle particularly suited for strengthening the hip extensor muscles of a user is described. The vehicle combines the therapeutic benefits of conditioning the hip extensor muscles with the enjoyable activity of propelling oneself on a wheeled vehicle. A frame is provided following the general pattern of a tricycle with one steerable wheel and a pair of driving wheels. A seat, a back rest, and at least one strap for holding the user in position on the seat and the back rest are also provided. These user support structures securely hold the user in the proper operating position, even when the user has less than normal muscular control and strength, such as with children with cerebral palsy. Structures are included for receiving at least a portion of the user's leg between the user's knee and the user's hip and for transmitting the extension motion of the user's hips into the rotational movement of the pair of driving wheels. Substantially only the hip extensor group of muscles of the user are used to propel the vehicle.

18 Claims, 2 Drawing Sheets



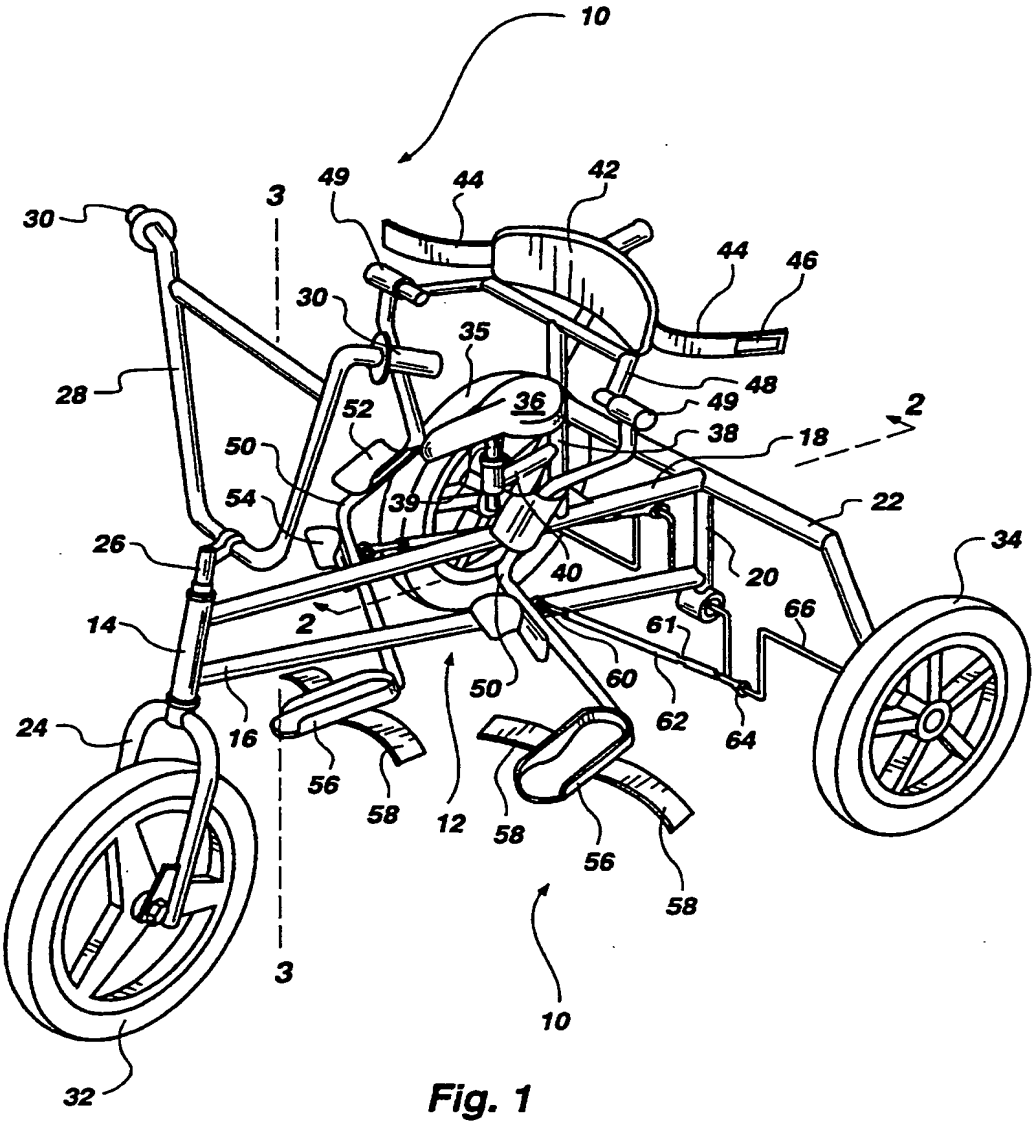

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Fig. 1

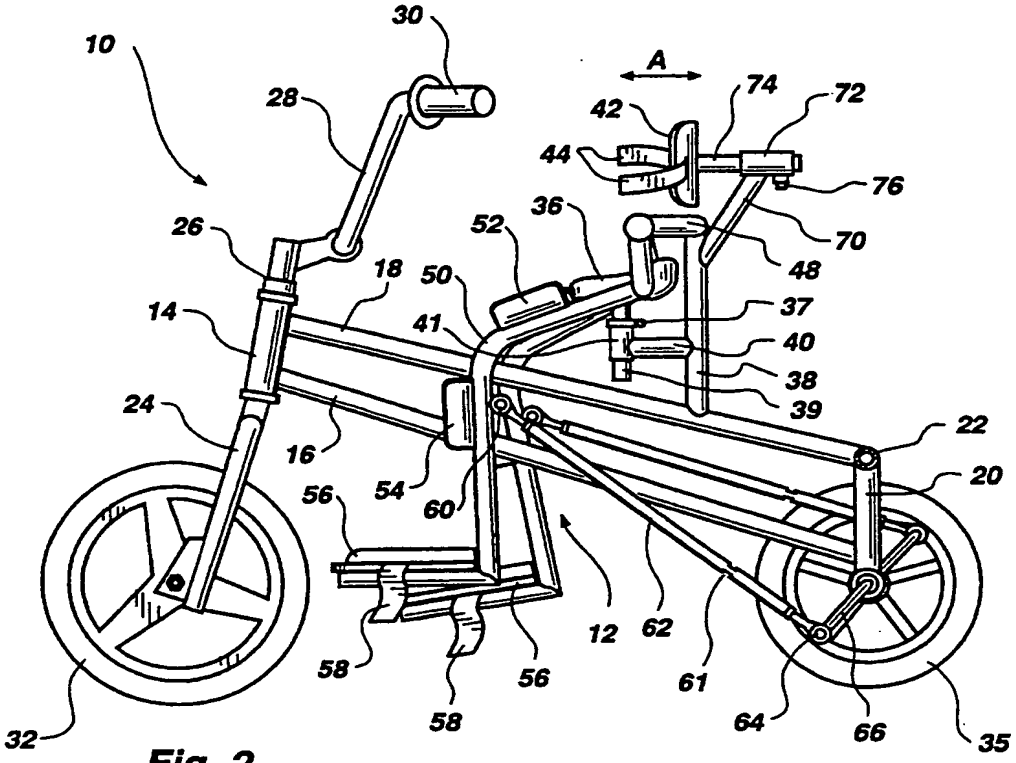
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Fig. 2

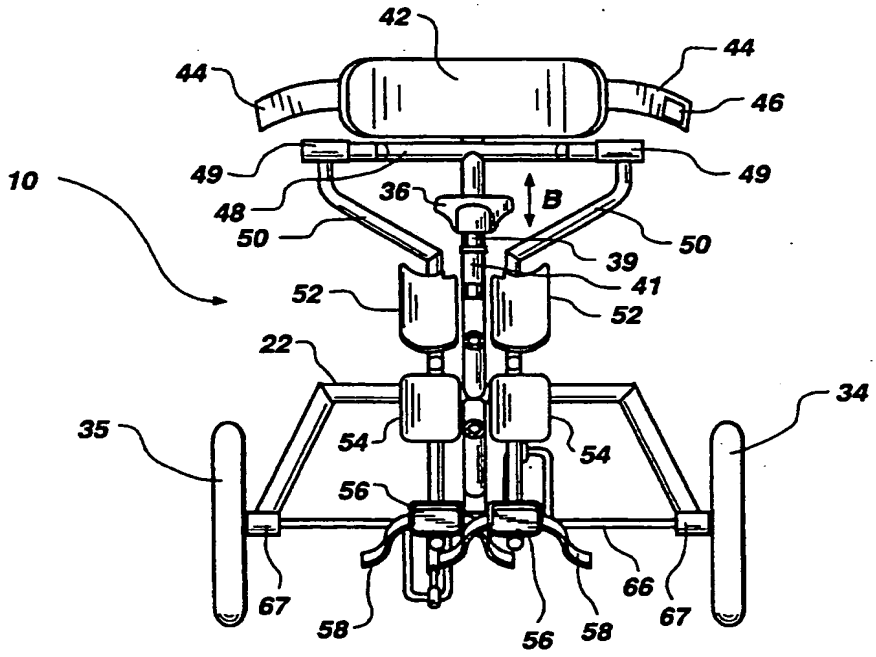
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Fig. 3

MUSCLE POWERED THERAPEUTIC VEHICLE

This invention was made with federal support under grant number 5T150H7141-14 awarded by the National Institute for Occupational Safety and Health (NIOSH). The government has certain rights in this invention.

This application is a continuation of application Ser. No. 07/888,724, filed May 26, 1992, now abandoned.

BACKGROUND

1. The Field of the Invention

This invention relates to human powered vehicles. More particularly, the present invention relates to therapeutic devices which are used to provide conditioning of specific muscles of the human body.

2. The Prior Art

The benefits of muscle powered activities are universally recognized. For example, the physiological benefits of pedaling a muscle powered wheeled vehicle, such as a bicycle or a tricycle, are well known. Unfortunately, some who need the benefits of such exercise the most are unable to use previously available bicycles and even tricycles.

In particular, children afflicted with cerebral palsy are generally unable to operate any of the previously available tricycles which are enjoyed by other children. Moreover, both adults and children may be afflicted with other disorders which make operating previously available bicycles and tricycles difficult or impossible. Thus, such persons are denied the benefits which accrue from such activities.

In particular, it is often the case that a person lacks either the muscle strength or coordination in the hip extensor muscles. Hip extensor muscles are critical for walking since they prevent trunk flexion and collapse. The hip extensor muscles are one of the major support muscles of the body used in standing and walking. Weakness of the hip extensor muscles cannot be treated with external bracing as is often the case with more distal muscles.

Moreover, in children with cerebral palsy who have undergone the selective dorsal rhizotomy procedure to reduce spasticity, hip extensor muscle weakness is frequently very pronounced. It is often the case that physical therapists work extensively (often for years) to strengthen these muscles in children with cerebral palsy. As a general rule, it is very difficult to strengthen muscles in children; they refuse to lift weights. However, children will ride tricycles. Disadvantageously, a conventional tricycle does not strengthen the hip extensor muscles; it primarily strengthens the quadriceps muscles.

Even though the is has been known for a long time that many persons, including children with cerebral palsy, are unable operate previously available tricycles, the problem of providing a muscle powered vehicle which can be operated by persons with particular disorders, and which will benefit such persons, has been unrecognized. Thus, in view of the inability of many individuals, for example children with cerebral palsy, to operate previously available bicycles and tricycles, it would be an advance in the art to provide a muscle powered wheeled vehicle which can be used by such individuals and which provides therapeutic conditioning to the hip extensor muscles.

BRIEF SUMMARY AND OBJECTS OF THE INVENTION

In view of the above described state of the art, the present invention seeks to realize the following objects and advantages.

It is a primary object of the present invention to provide a wheeled apparatus which can be powered by a person with impaired muscle control.

It is yet another object of the present invention to provide a muscle powered wheeled vehicle which can be operated by a child afflicted with cerebral palsy.

It is another object of the present invention to provide a muscle powered wheeled vehicle which will promote improvement in the walking gait of children with cerebral palsy.

It is a further object of the present invention to provide a muscle powered wheeled vehicle which promotes activation of the hip extensor muscles in a similar or greater amount than walking.

The present invention provides a therapeutic wheeled vehicle particularly suited for strengthening the hip extensor muscles of a user. The present invention combines the therapeutic benefits of conditioning the hip extensor muscles with the enjoyable activity of propelling oneself on a wheeled vehicle. Children, particularly those with disorders such as cerebral palsy, benefit from the present invention.

Embodiments of the present invention include a frame which is preferably constructed using materials and techniques similar to those used in bicycle and tricycle construction. The preferred embodiment of the present invention follows the general pattern of a tricycle having one steerable wheel and a handlebar connected to the frame and a pair of driving wheels connected to the rear of the frame.

A seat, a back rest, and at least one strap for holding the user in position on the seat and the back rest are also provided. These user support structures securely hold the user in the proper upright operating position, even when the user has less than normal muscular control and strength.

Importantly, the present invention includes means for receiving at least a portion of the user's leg between the user's knee and the user's hip preferably including means for receiving the back of the user's thigh. The present invention also includes means for transmitting the reciprocating movement of the user's hip into the rotational movement of the driving wheel or wheels such that the vehicle can be propelled by the hip movement of the user. The desired hip movement of the user is extension of the hip joint. In the preferred embodiment of the present invention, each of the user's legs are coupled to the driving wheels such that as the hip joints are alternately moved to extend the legs of the user the vehicle is propelled. Substantially only the hip extensor group of muscles are used to propel the vehicle thus providing conditioning for that specific group of muscles.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to better appreciate how the above-recited and other advantages and objects of the invention are obtained, a more particular description of the invention briefly described above will be rendered by reference to a specific embodiment thereof which is illustrated in the appended drawings. Understanding that these drawings depict only a typical embodiment of the invention and are not therefore to be considered limiting of its scope, the invention will be described and explained with additional specificity and

detail through the use of the accompanying drawings in which:

FIG. 1 is a perspective view of the presently preferred embodiment of the therapeutic vehicle of the present invention.

FIG. 2 is a cross sectional view of the therapeutic vehicle taken along line 2—2 of FIG. 1.

FIG. 3 is a cross sectional view of the therapeutic vehicle taken along line 3—3 of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made to the drawings wherein like structures will be provided with like reference designations.

FIG. 1 provides a perspective view of the presently preferred example the therapeutic vehicle of the present invention. The described embodiment is particularly suited for use by children with cerebral palsy. Those skilled in the art will appreciate that the present invention has application with persons other than children and with disorders other than cerebral palsy. Still, the illustrated therapeutic vehicle will be described herein as being used with children having cerebral palsy with the understanding that the teachings provided herein can readily be used to provide therapeutic vehicles to benefit others.

As mentioned, children with cerebral palsy generally have deficient strength and control in the group of muscles used to extend the hip joint. The group of muscles involved in the extension motion of the hip principally includes the gluteus maximus muscle as well as, to a lesser extent, the biceps femoris, the semitendionosus, and the semimembranosus muscles which will collectively be referred to herein as the "hip extensor muscles."

Since the hip extensor muscles are critical to having a proper walking gait, these muscles must be developed in order for a child to walk properly. Unfortunately, children are notoriously uncooperative when required to engage in therapeutic exercise per se. With the therapeutic vehicle of the present invention, the hip extensor muscles are generally activated to a greater extent than with other modes of therapy suitable for children and the children find operating the vehicle to be an enjoyable activity. Thus, the child obtains the benefit of the therapeutic hip extensor muscle action while enjoying a common childhood activity which could not otherwise be enjoyed.

The therapeutic vehicle, generally represented at **10** in the figures, includes a frame, generally indicated at **12**, and three wheels **32**, **34**, and **35**, a handlebar **28**, a seat **36**, and drive components which will be described in detail later. Importantly, the vehicle **10** is configured as a three wheel tricycle to ensure a proper amount of stability and safety for the user. It is, however, within the scope of the present invention to use only two wheels, or more than three wheels, in embodiments of the present invention.

The frame **12** is preferably constructed using techniques used to construct bicycle frames. The frame **12** of the illustrated vehicle **10** includes a top tube **18**, a rear driving wheel tube **22**, a hanger tube **20**, a down tube **16** and a head tube **14**. The particular frame geometry illustrated in the figures is preferred but many other frame geometries and types of frame-like structures can be used within the scope of the present invention.

The front wheel **32** is attached to a fork **24** which is rotatably mounted in the head tube **14** preferably using bearing structures (not represented in the figures) available in the art. A stem **26** connects the handle bar **28** to the fork **24**. The handle bar **28** is provided with grips **30** as is known in the art. The front wheel and the components associated with it are used to steer the therapeutic vehicle **10**. As will be appreciated by those skilled in the art, these structures can be fabricated using components and techniques known in the art or one skilled in the appropriate art can take advantage of other components and techniques which would be suitable for fabrication of an embodiment of the present invention.

The illustrated therapeutic vehicle **10** includes two rear driving wheels **34** and **35**, which, as in the case of the front wheel **32**, preferably are of the type generally used in the bicycle and tricycle art. The rear driving wheels **34** and **35** are connected to an axle **66** which is connected to the frame **12** by way of bearing member **67**, as shown best in FIG. **3**. As will now be explained, the axle **66** is coupled to the legs of the user (not represented in the figures) so that the action of the hip extensor muscles alone will propel the therapeutic vehicle **10** thereby providing conditioning to said group of muscles.

As mentioned, the illustrated therapeutic vehicle **10** is particularly intended for use by children having cerebral palsy who, in order to obtain maximum benefit from the present invention, require support structures to keep their body in position as they use their hip extensor muscles to propel the therapeutic vehicle **10**. In order to provide such support, a seat **36** and a back rest **42** are provided in the illustrated therapeutic vehicle **10**. In order to transmit the action of the hip extensor muscles to the rear driving wheels **34** and **35**, a crank **50** is provided for each leg of the user. Each of the cranks **50** hang from pivots **49** as will be explained more fully shortly.

As shown best in FIG. **2**, a seat **36** is provided to give vertical support to the user. The seat **36** is connected to a seat post **39** which can be locked into a vertical position using a locking bolt **37**. A seat arm **40** is connected to a support tube **38** which is connected to the top tube **18** of the frame. The seat post **39** slides vertically within a sleeve **41** until the locking bolt **37** is tightened.

Referring now to FIG. **3**, for best results, the height of the seat **36** should be adjusted in the direction of arrow B so that the hip joints of the user are at the same height as the crank pivots **49**. Thus, lining up the crank pivots **49** approximately with the acetabulum, slightly above the greater trochanter of the hip, will generally be satisfactory. Other positions, however, may also be used as determined by experience with users of the therapeutic vehicle **10**.

Referring now to the side view of FIG. **2**, the back rest **42** is also provided to keep the user in the proper upright position. Also included is a strap **44** which wraps around the torso of the user and keeps the back of the user against the back rest **42**. As can be seen best in FIG. **1**, the back rest preferably has a curved shape to cradle the user's torso. The strap **44** is preferably provided with lengths of hook and pile fastener (one patch of which is represented at **46**) to hold the strap together around the user. A buckle or some other type of fastener can be used on the strap **44** in place of the preferred hook and pile fastener **46**.

As illustrated best in FIG. **2**, the back rest **42** can be moved forward and backward in the direction of arrow A. The back rest **42** is attached to a back rest post **74** which passes through a sleeve **72**. A locking bolt **76** positioned on the sleeve **72** holds the back rest **42** in position when tightened. A strut **70** connects the sleeve **72** to the support tube **38**. While use of the user support structures described

herein is preferred, other arrangements may also be used within the scope of the present invention. Furthermore, it is within the scope of the present invention to orient the user in positions other than the described upright position.

While being securely held in the proper position, the user can propel the therapeutic vehicle by using substantially just the hip extensor muscles. The drive train components, which will now be described in detail, function to couple the movement of the hip extensor muscles to the driving wheels **34** and **35**. As will be appreciated, the drive train components used in embodiments of the present invention should provide support for the legs of the user so that primarily the hip extensor muscles are used and lack of strength or coordination in other muscles does not hinder the use of the present invention.

As illustrated best in FIG. **1**, the cranks **50** are shaped so that as the user's leg is rested thereupon the knee of the user is comfortably bent. A thigh support **52** is included on the crank **50** and receives the back of the user's thigh. A calf support **54** is also provided on the crank **50** to hold the user's calf in place. A foot rest **56** receives the user's foot and a strap **58**, which can be provided with some type of fastener such as a hook and pile fastener, holds the user's foot in place. Similarly, if desired, the thigh support **52** and the calf support **54** can also be provided with straps to hold the user's legs in place.

A first connecting rod extension **60** is pivotally connected to each of the cranks **50**. Each of the connecting rod extensions **60** are attached to a connecting rod **62** which is in turn joined to a second connecting rod extension **64** which is rotationally connected to the eccentric portion of the axle **66**.

Preferably, the effective length of the connecting rod **62** can be altered to increase or decrease the mechanical leverage provided between the cranks **50** and the axle **66**. It is also within the scope of the present invention to provide a friction brake on one or more of the wheels **32**, **34** and **35**, or on the axle **66** or other structure in order to provide additional mechanical resistance to the propulsion of the therapeutic vehicle or to limit the speed thereof.

In the described therapeutic vehicle **10**, the connecting rod **62** is provided with internal threads (not shown) which are engaged by external threads (not shown) provided on the first connecting rod extension **60** and the second connecting rod extension **64** and which allow the combined length of these structures to be increased or decreased by rotating the rod **62**. A flat **61** is provided on the rod **62** to allow the rod to be gripped by a wrench and turned. Other structures can also be used, such as a turn buckle (not represented), to alter the length of the structures connecting the cranks **50** to the axle **66**. It will be appreciated that it is also within the scope of the present invention to provide structures which allow changing the position at which a structure corresponding to the first connecting rod extension **60** is joined to the crank **50** or the changing eccentricity of the eccentric portion of the axle **66**. Moreover, while the illustrated structure is preferred, it is within the scope of the present invention to use completely different arrangements to couple the movement of the user's hip extensor muscles to the driving wheels. As will now be appreciated, using the structure represented in the figures, as the user alternately activates his left side and right side hip extensor muscles, the cranks **50** will alternately pivot resulting in the rotation of the rear driving wheels **34** and **35**.

In view of the foregoing, it will be appreciated that the present invention provides a muscle powered wheeled vehicle which can be readily operated by a child afflicted with cerebral palsy and which conditions the hip extensor muscles as it is used. The strengthening of the hip extensor muscles provided by the present invention promotes improvement in the walking gait of children with cerebral palsy and others as well. The present invention also provides a therapeutic vehicle which promotes activation of the hip extensor muscles in a similar or greater amount than walking and which is often more productive than other types of therapy.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiment is to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed and desired to be secured by United States Letters Patent is:

1. A wheeled vehicle capable of being propelled by a user which is carried thereon, including users with less than normal muscular control and strength, the vehicle comprising:

a frame;

at least one steerable wheel connected to the frame;

user support means for supporting the user on the frame;

steering means for allowing the user to steer the steerable wheel;

means for receiving at least a portion of the user's thigh at a position on the user's leg between the user's knee and the user's hip, the means for receiving at least a portion of the user's thigh comprising means for receiving the back of the user's thigh such that contact with the back of the user's thigh is made and the means for receiving the back of the user's thigh is moved by the hip extension motion of the user;

means for pivotally connecting the means for receiving at least a portion of the user's thigh to the frame at a point in substantial alignment with the user's hip;

driving wheel means connected to the frame, the driving wheel means comprising a wheel and means for transmitting any extension motion of the user's hip into the rotational movement of the driving wheel means, the driving wheel means comprising an axle connected to a driving wheel, the axle having an eccentric portion thereof and the means for receiving at least a portion of the user's thigh comprising means for connecting the back of the user's thigh to the eccentric portion of the axle; and

means for transmitting the extension motion of the user's hip into the rotational movement of the driving wheel means such that the vehicle can be propelled by the hip extension motion of the user.

2. A wheeled vehicle as defined in claim **1** wherein the frame comprises:

a top tube;

a down tube; and

a head tube.

3. A wheeled vehicle as defined in claim **1** wherein the user support means further comprises:

a seat;

means for selecting a vertical height for the seat;

a back rest;

means for selecting a horizontal position for the back rest; and a strap positioned on the back rest.

4. A wheeled vehicle as defined in claim 1 wherein the driving wheel means comprises:

a first rear driving wheel; and

a second rear driving wheel.

5. A wheeled vehicle as defined in claim 1 wherein the means for receiving at least a portion of the user's thigh further comprises means for pivoting the means for receiving the back of the user's thigh about a point in substantial alignment with a hip of the user.

6. A wheeled vehicle as defined in claim 5 wherein the means for receiving at least a portion of the user's leg further comprises:

means for receiving the back of the user's calf; and means for receiving the user's foot.

7. A wheeled vehicle as defined in claim 1 wherein the driving wheel means comprises two rear driving wheels.

8. A wheeled vehicle as defined in claim 1 further comprising means for changing the mechanical leverage provided between the axle connected to the driving wheel and the means for connecting the back of the users thigh to the eccentric portion of the axle.

9. A wheeled vehicle as defined in claim 8 wherein the means for changing the mechanical leverage provided between the axle connected to the driving wheel and the means for connecting the back of the user's thigh to the eccentric portion of the axle comprises means for altering the effective length of the means for connecting the back of the user's thigh to the eccentric portion of the axle.

10. A therapeutic wheeled vehicle for strengthening the hip extensor muscles of a user as it is being propelled by the muscle power of the user which is carried thereon, the therapeutic vehicle comprising:

a frame;

a steerable wheel connected to the frame;

a seat adapted for supporting the user above a portion of the frame;

a rest adapted for horizontally supporting the user on the seat including users with less than normal muscular control and strength;

a strap for holding the user in position on the seat and the rest;

handle bars connected to the steerable wheel for allowing the user to steer the steerable wheel;

a pair of driving wheels, each of the driving wheels rotatably joined to the frame;

an axle connecting the pair of driving wheels;

first means for receiving at least a portion of the user's left thigh between the user's left knee and the user's left hip, the first means for receiving comprising means for receiving the back of the user's left thigh such that contact with the back of the user's left thigh is made and the means for receiving the back of the user's left thigh is moved by the left hip extension motion of the user and such that the means for receiving the user's left hip pivots about a point in substantial alignment with the left hip of the user;

second means for receiving at least a portion of the user's right thigh between the user's right knee and the user's right hip, the second means for receiving comprising means for receiving the back of the user's right thigh such that contact with the back of the user's right thigh is made and the means for receiving the back of the user's right thigh is moved by the right hip extension motion of the user and such that the means for receiving the user's right hip pivots about a point in substantial alignment with the right hip of the user;

means for transmitting the alternating extension motion of the user's first and second hip muscles to the axle such that rotational movement of the pair of driving wheels is produced and such that the vehicle is propelled by the movement of the user's hip extensor muscles.

11. A wheeled therapeutic vehicle as defined in claim 10 wherein the frame comprises:

a top tube;

a down tube; and

a head tube.

12. A wheeled therapeutic vehicle as defined in claim 10 further comprising:

means for receiving the back of the user's left calf;

means for receiving the user's left foot, the means for receiving the back of the user's left calf and the means for receiving the user's left foot being connected to the means for transmitting;

means for receiving the back of the user's right calf; and

means for receiving the user's right foot, the means for means for receiving the back of the user's right calf and the means for receiving the user's right foot being connected to the means for transmitting.

13. A wheeled therapeutic vehicle as defined in claim 10 further comprising means for changing the mechanical leverage provided between the first means for receiving and the second means for receiving and the means for transmitting.

14. A wheeled therapeutic vehicle as defined in claim 10 wherein the means for transmitting comprises a rod interconnecting the first means for receiving and the axle, the axle having an eccentric portion thereof, and wherein the means for changing the mechanical leverage comprises means for altering the effective length of the rod which interconnects the first means for receiving to the eccentric portion of the axle.

15. A wheeled vehicle capable of being propelled by a user which is carried thereon, the vehicle comprising:

a frame;

at least one steerable wheel connected to the frame;

user support means for supporting the user on the frame;

steering means for allowing the user to steer the steerable wheel;

driving wheel means connected to the frame and comprising a wheel;

means for receiving at least a portion of the user's thigh at a position on the user's leg between the user's knee and the user's hip, the means for receiving at least a portion of the user's thigh comprising:

means for receiving the back of the user's thigh such that contact with the back of the user's thigh is made;

means for pivoting the means for receiving the back of the user's thigh about a point in substantial alignment with a hip of the user;

means for receiving the back of the user's calf; and

means for receiving the user's foot;

and the means for receiving the back of the user's thigh is moved by the hip extension motion of the user; and

means for transmitting the extension motion of the user's hip into the rotational movement of the driving wheel means such that the vehicle can be propelled by the hip

extension motion of the user, said means for transmitting comprising an axle connected to the driving wheel, the axle having an eccentric portion thereof and means for connecting the back of the user's thigh to the eccentric portion of the axle.

16. A wheeled vehicle as defined in claim 15 wherein the driving wheel means further comprises two rear driving wheels.

17. A wheeled vehicle as defined in claim 15 further comprising means for changing the mechanical leverage provided between the axle connected to the driving wheel and the means for connecting the back of the user's thigh to the eccentric portion of the axle.

18. A wheeled vehicle as defined in claim 17 wherein the means for changing the mechanical leverage provided between the axle connected to the driving wheel and the means for connecting the back of the user's thigh to the eccentric portion of the axle comprises means for altering the effective length of the means for connecting the back of the user's thigh to the eccentric portion of the axle.

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